THE STUDENT.

CORYTHAIX LEUCOLOPHA.

THE

STUDENT

AND

INTELLECTUAL OBSERVER

OF

SCIENCE, LITERATURE AND ART.

VOLUME II.

ILLUSTRATED WITH PLATES IN COLOURS AND TINTS AND NUMEROUS ENGRAVINGS ON WOOD

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CONTENTS.

ILLUSTRATIONS.

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TINTED PLATES.

ENGRAVINGS ON WOOD.

THE STUDENT,

AND

INTELLECTUAL OBSERVER.

TOURACOES AND THEIR DISTRIBUTION.

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Secretary to the Zoological Society of London.

(*With a Coloured Plate.*)

PROFESSOR CHURCH'S interesting article upon "Turacine," published in the first volume of this journal,* may have induced some of the readers of THE STUDENT to wish to know a little more about the family of birds which produce this curious animal pigment. I have, therefore, had great pleasure in complying with a request to put together a few notes upon some of the peculiarities of the Touracoes, and upon their geographical distribution, which offers several points of interest.

In accordance with the views of some of the older systematists, Professor Church has stated that the Touracoes form a sub-family of the Cuckoos (Cuculidæ). While, however, there can be no doubt of the affinity of these two groups, the general consent of the best zoologists of the present day has raised the Touracoes to the rank of a family (Musophagidæ), quite equivalent in value to the Cuculidæ, and occupying a corresponding place in the natural system. This is abundantly justifiable upon structural grounds, whether we consider the external or internal characters of the two groups. In the first place, the Cuculidæ belong to the true "Zygodactylæ"—that

* Vol. i., p. 161.

is, have the toes arranged in pairs, two before and two behind, the external toe, which is in most birds directed forwards, being usually turned backwards, along with the normal hind-toe, although it is in some cases more or less versatile. In the Touracoes, although there is a power of turning the outer toe backwards, this digit is usually directed forwards, and is always more or less versatile. Again, the Cuckoos have no after-shaft, or accessory plume, on their body-feathers, while this is always present in the Touracoes, and in the latter the tip of the oil-gland is feathered, whereas in the Cuckoos this organ is quite naked.*

Of the osteological differences between the Touracoes and the Cuckoos, no sufficient account has yet been given; but the skeletons of these two forms are easily recognizable on comparison. The palatine bones of the Musophagidæ present some curious modifications, and are stated by Professor Huxley to have a certain resemblance to those of the owls. The sternum of the Touracoes, to which M. Blanchard has devoted a chapter in his excellent (but, unhappily, unfinished) article upon this part of the bird's structure, is likewise easily distinguishable from that of the Cuckoos, and more nearly resembles that of the Toucans.

We may, therefore, fairly consider the Touracoes, or Musophagidæ, as constituting a well-marked family of the class of birds most nearly allied to the Cuckoos, and more distantly to the Toucans (Rhamphastidæ), Puff-birds (Bucconidæ), and Jacamars (Galbulidæ). In all these last-mentioned groups of birds, the fourth toe, as well as the first, is permanently turned backwards, just as in the woodpecker and wrynecks (Picidæ and Yungidæ), which, however, are distinguishable by other very trenchant characters. But in the Touracoes, as we have already stated, the fourth toe is versatile, and may be turned either way, being usually carried, more or less nearly, at a right angle from the first and third.

As regards habits, the Touracoes are a strictly arboreal group of birds, passing the greater part of their lives upon forest trees, and seldom, if ever, descending to the ground. They are mostly of brilliant plumage, and of moderate size—about that of a domestic pigeon—and are particularly active and lively in their movements. Those in the Zoological Society's aviaries never seem to be still for a minute, being constantly engaged in flitting from one perch to another, and alternately elevating and depressing their elegant crests. Their food, in a state of nature, is mostly, if not entirely, fruit, the name of

* For a complete account of the pterylographic differences of these groups, see "Nitzsch's Pterylography," Ray Society's Translation, London, 1867, pp. 90, 106.

the principal genus, *Musophaga*, being formed from their well-known partiality for the fruit of the plaintain (*Musa*). We have as yet no very authentic details as to their mode of nidification; but it is usually stated that they build in hollow trees, and lay white eggs. The sexes, as far as is known, in all species of this group are coloured alike, or very nearly so.

As in the case of other groups of birds, the Touracoes have been divided by modern systematists into numerous small genera; but it is more natural, as well as more easily intelligible, to consider them as forming only three genera, which may be distinguished among themselves by very simple characters. These are, *Musophaga*, *Corythaix*, and *Schizorhis*. In the *Musophagæ*, or Plaintain-eaters, the culmen of the bill, at the base, is produced into a frontal shield, which covers the forehead, and the nostrils are oval. In *Corythaix*, or the true Touracoes, there is no frontal shield, and the nostrils are oval. In *Schizorhis*, or the False Touracoes, there is likewise no frontal shield, but the nostrils, as indicated by the name, are linear in shape.

Only two of the first genus, or Plantain-eaters, are known to science, and one of these (Ross's Plantain-eater) is very scarce, but a single specimen of it having been known to occur. The other, commonly called the Violet Plantain-eater, is the most brilliantly-coloured bird of the group, and, indeed, of the whole African Ornis. The plumage is of a rich dark purple, with crimson wings and head, while the bill and head-shield are yellow and red. This magnificent bird is not unfrequently brought alive to Europe, and forms a splendid ornament to our aviaries. It does not, however, thrive very well in captivity.

The second genus (Corythaix) comprehends some ten or twelve species, which are divisible into three sections. The first of these embraces only the remarkable *Corythaix porphyreolopha*, discovered originally by Sir Andrew Smith in Natal, and confined to the south-eastern portion of the African continent. Dr. Kirk also met with this bird on the lower course of the Zambezi, but tells us that it does not extend into the higher country of the interior. The Purple-crested Touraco is easily distinguishable from its numerous congeners of the next section by having the nostrils quite exposed and naked, and forms a transition between the Plantain-eaters and Touracoes.

The second section of Corythaix contains nine species; amongst which are the best-known birds of the genus. In these the nostrils are always more or less concealed by the projecting frontal plumes.

All of them bear a peculiar erectile compressed crest, something like the short-cut mane of a hobby horse, which is often edged with a different colour at its upper margin. In most of them the crest is green, but in one peculiar species, which I have selected as an illustration of the group, the crest is pure white, without any border. This rare and remarkable bird, the White-crested Touraco, or *C. leucolopha* of naturalists, was discovered by the well-known African traveller, Theodor von Heuglin, in 1852, during his sojourn in the country of the Bari negroes, on the Upper Nile, between the fourth and fifth degrees of north latitude. The plate has been copied from a coloured figure drawn by the discoverer of the species, who, in addition to other special qualifications as a naturalist, possesses the advantage of being an excellent artist.

To the typical section of the genus Corythaix which we are now considering, belong the two West African species which are most commonly brought to Europe alive, namely, Buffon's Touraco (*C. Buffoni*) and the Senegal Touraco (*C. persa*). Living examples of these birds may usually be found in the large aviary in the Zoological Society's Garden, situated immediately to the right of the principal entrance-gate.

The third and remaining section of the genus Corythaix contains only the Giant Touraco (*C. gigantea*), which stands alone, being not only remarkable for its large size, but also diverging in several points of structure from its brethren. In this bird the peculiar crimson colour of the primaries and secondaries which is found in every other species of Corythaix, as well as in Musophaga, and supplies turacine, is not present, the wing-feathers being all of a uniform green like the back. This is also the case in the False-Touracoes (Schizorhis), between which and Corythaix the Giant Touraco forms a link. This fine and powerful bird inhabits the tropical forests of Western Africa, from Sierra Leone down to the river Congo, where specimens have lately been obtained by Mr. J. J. Monteiro.

We are now arrived at the third and last genus of the family Musophagidæ—the False Touracoes (Schizorhis), which have the nostrils linear and naked, and none of which have the peculiar *turacine*-producing colour on the wing-feathers. Five species are known of this group, distributed over various parts of Africa. Although some of these birds are provided with a crest, I doubt whether that organ is ever erected and depressed after the manner of the true Touracoes. Mr. J. J. Monteiro, speaking of the Grey

False-Touraco (*S. concolor*), as observed in Benguela, expressly states that the crest-feathers are always carried erect.*

I must now conclude with a few remarks upon the geographical distribution of the Touracoes, to illustrate which a summary of the known species of the family, and of the different parts of Africa in which they are found, will be convenient.

TABLE SHOWING THE DISTRIBUTION OF THE TOURACOES.

		East Africa.	West Africa.	South Africa.
1	Musophaga violacea . . .		——	
2	„ Rossæ . . .		——	
3	Corythaix porphyreolopha .			——
4	„ leucolopha . .	——		
5	„ leucotis . . .	——		
6	„ erythrolopha . .		——	
7	„ macrorhyncha .		——	
8	„ meriani . . .		——	
9	„ persa		——	
10	„ Buffoni . . .		——	
11	„ albicristata . .			——
12	„ Livingstonii . .			——
13	„ gigantea . . .		——	
14	Schizorhis concolor . . .			——
15	„ personata . . .	——		
16	„ leucogastra . .	——		
17	„ Africana . . .		——	
18	„ zonura	——		
		5	9	4

As will be seen by this table, the Touracoes are found only in Africa, and, in fact, form one of the most characteristic groups of what is now generally denominated the "Æthiopian Region," being absolutely unknown in other parts of the world's surface.

* See Mr. Monteiro's "Notes on Birds Collected in Benguela." "Proc. Zool. Soc., 1865," p. 89.

Just as a geologist may often recognize a stratum by one peculiar fossil, so a naturalist, upon inspecting a collection of birds in which a single skin of a Touraco occurred, would say with certainty, "This collection was formed in some part of Africa." Several other groups of birds have exactly the same distribution—such as the Colies (Coliidæ), the Ox-peckers (Buphaga), and the Guinea-fowls (Numididæ)—and serve to differentiate the Æthiopian from the Indian Region.

Moreover, each part of the Æthiopian Region is found to be tenanted by a different set of species of Touracoes. In Nubia, Abyssinia, and the Egyptian Sudan, which I have associated together under the name "Eastern Africa," five species of Touracoes occur, none of which are found elsewhere. The forests of Western Africa, extending from Senegal down to the Congo, have hitherto yielded us nine species of the group, none of which are known in the other parts of Africa. Lastly, Southern Africa, including all the southern portion of that great continent up to the tenth degree of south latitude, furnishes us with four peculiar species.

We have not now space to enter upon the geographic limits of each species of Touraco. But an attentive study of what is known of this subject, and of what has been already stated, will lead to the following results, which may be accepted as among the acknowledged principles of the theory of the geographical distribution of animals :—

1. Every natural family-group of animals occupies a definite limited continuous area of the earth's surface, which may be called the *area familiaris*, or familiar area; and within which every member of the family is confined.

2. Every natural genus of the family in the same way occupies a definite limited continuous area, called the *area generica*, or generic area—within which every species of the genus is confined.

In the case of Musophaga, the generic area consists of a certain portion of Western Africa. In the case of Corythaix and Schizorhis, the generic area (as is not unfrequently the case) is coextensive with the familiar area.

3. Lastly, each species occupies a definite limited continuous area, called the *area specifica*, or specific area, within which every individual of the species is confined.

THEORY OF THE LEAF.

BY CASIMIR DE CANDOLLE.*

EVERY leaf of a phanerogamus plant begins as a cellular outgrowth, the base of which embraces a portion of the stem proportioned to the space which will form the insertion of the leaf at a later period. Thus the leaves whose sheath envelopes the axis on all sides (*Platanus occidentali*, the plane-tree), commences by an annular outgrowth surrounding this axis. This is likewise the case with certain opposite and sheathed leaves which appear simultaneously under the form of a single annular outgrowth (*Galium*). The highest powers of the microscope show nothing in this outgrowth but a homogeneous structure which is called the *primordial leaf*. From this primordial leaf are developed all the parts which make up the adult leaf. These parts appear in succession. Those first formed, which are called parts of the first order, spring directly from the primordial leaf; and those of the second order spring from the first, and so on in succession. Parts of the same order form themselves, sometimes from below upwards, sometimes from above downwards. Moreover, the formation of parts of the same order may take place in the same direction or in an opposite one to those of the order preceding. The primordial leaf can produce appendages, not only on the lateral margin (stipules, etc.), but also on its posterior surface† (wings of petioles, etc.). Ordinarily the appendages of the posterior surface grow after those of the sides. Such is a brief *resumé* of the fine researches of Steinheil, Trécul, Nägali, Schacht, and Eichler. We see that the theory according to which the leaf is developed only from above downwards —a theory sustained by Schleiden—is now entirely abandoned. We have also arrived at the conclusion that the stipules are appendages of the primordial leaf, and not the direct products of the stem.

The successive development of parts of the leaf, often in a basifugal direction, lead to its being likened to a branch of limited growth. Such a definition would be inconvenient, as it takes no account of the fact that many leaves do not appear to possess appendages, except on their lateral margins, and that these appendages

* Translated from the "Archives des Sciences," from which also the illustrations are borrowed.

† By posterior surface is meant that which faces the axis of the stem; the anterior, that which faces the observer, supposing the leaf upright.

often grow from above downwards, while the leaves of a branch are always developed from below upwards.

A recent study of the leaves of the Piperaceæ having led me to observe the development of their fibro-vascular bundles, I have arrived by a different route at the great question of the true nature of the leaf. The internal structure of certain leaves of the Piperaceæ appear to me to represent that of a branch with its posterior half atrophied. In fact, I noticed many cases in which the fibro-vascular structure, ordinarily limited to the anterior half of the leaf, was continued through the posterior region, under the form of bundles of collenchyma, identical with those which accompany each ligneous bundle in the anterior region, (*P. sidæfolium, L.*) This observation, suggesting the possibility of a ligneous formation in the whole circumference of a leaf, naturally led me to compare a leaf with a branch, and to hazard a definition that it was a branch with the posterior surface atrophied.

* * * * *

The mode of observation which I have adopted has consisted in determining the course of the ligneous bundles in each leaf by means of numerous sections made in all directions. Thus we arrive at a clear idea of the plan of the fibro-vascular system from one end of the leaf to the other. Each section must be examined under the microscope with a pretty strong power, for it frequently happens that a bundle which at first seems single, is really composed of an agglomeration of distinct bundles. A leaf is always provided with cortical bundles situated in front of ligneous bundles, and formed of collenchyma. As these bundles of collenchyma follow the direction of the ligneous bundle, it is sufficient to describe the latter to give a complete idea of the whole fibro-vascular system.

It has been long known that the leaf-ligneous bundles which grow the first, are common to the leaf and its stem, and are directly prolonged from one to the other. It was also known that these first bundles grow in such an order that those which in the petiole correspond with the ridge of mid-vein were formed first, and that the others appeared successively from the front to the back, so that the first formed are nearest to the posterior surface of the leaf. This law appears to have no exception, and I have verified it in many species, especially in *Pterocarya fraxinifolia*. Most commonly the formation of these bundles stops before reaching the posterior region, and a transverse section there shows only a larger or smaller arc of bundles (Fig. 1). Sometimes, however, it happens that the ligneous formation continues throughout the circumference of the

leaf, whether in the leaf-blade (*limbe*), or in the petiole. A transverse section of the margin then shows that ligneous fibres exist on each side, and one of the petiole exhibits a ligneous circle identical with that of the stem. Leaves of this kind are, in some sort, true branches, more or less flattened and deprived of their terminal bud. *Acer pseudo-platanus, Platanoides, Populus nigra*, etc.

The leaves of the sycamore (*Acer pseudo-platanus*) and of the black poplar (*P. nigra*) (Figs. 2, 3, 4, 5, and 6, 7, 8, 9), afford the most perfect examples that I know of complete fibro-vascular bundles. Not only is the formation of ligneous tissue continued through the whole circumference, but the parenchyma of the two halves, posterior and anterior, is developed equally in length, so that their leaf-blades result from a simple lateral expansion of tissues. In the black poplar the perfection is so complete, that it exists in the ligneous bundles of the highest order on the posterior surface, while, in the sycamore, we only find primary, secondary, and tertiary bundles, those of the ulterior orders being only represented by the corresponding collenchyma.

Many cylindrical leaves were already known in which the bundles were equally distributed in all parts; but no author appears to have noticed that in flat leaves, such as those of the maple and poplar, the same structure occurred. Peltate leaves may be placed in the same category; their bundles are spread equally through the circumference of the petiole, from whence they diverge to the leaf-blade. * * * *

The leaves of the maple family (Acerina) exhibit a peculiarity worth notice. If we follow the course of the common bundles of this family from the tip of the leaf-blade to the stem, we find each bundle of the posterior side, on reaching the thin portion of the leaf, applies itself to the opposite bundle on the anterior surface, and travels with it to the stem. Hence, towards the insertion, the bundles appear doubled, and their section exhibits a mass of tracheæ placed between two layers of cambium, of which one is turned towards the stem, and the other towards the observer.

There exist likewise many leaves (*Protea cynaroides, Viscum album*—section of the latter, Fig. 10), in which all the bundles are covered with cambium on both sides, throughout their entire course from the stem to the margin of the leaf-blade. * * * * The phyllodia of certain acacias are also leaves with complete fibro-vascular systems, as may be seen by looking at their transverse section, as shown in Fig. 11.

In the majority of non-peltate leaves, the posterior region of the

leaf-blade is entirely destitute of ligneous bundles, and often even of collenchyma. This absence of the posterior fibro-vascular system is often very marked in the petiole, the transverse section of which exhibits only an arc of bundles. * * * * *

The first ligneous bundles of the leaf grow in succession from the front backwards, and it is easy to show, by a transverse section of young petioles (Figs. 12, 13, 14, 15), that each new row of bundles is formed inside the preceding row. The bundles of all these rows alternate with each other, so that they tend to intercalate themselves among those of the first, with which they end in forming one and the same row, when the growth of the petiole has pushed them back towards the periphery. In many leaves the appearance of the bundle is preceded by the formation of a ring of cambium (*juglandaceæ*, etc.), in which they are formed by successive intercalations, as in the stem. The ring which results from the junction of the first bundles of the cambium is formed, according to the usual law, from the front backward. This law, which usually regulates the successive appearance of the bundles of the two or three first rows (*Aralia digitata*), does not always seem to regulate the formation of subsequent rows, for it may find itself in contradiction with the basipetal development of many secondary and tertiary veins. It is true that the veins, in appearance of the same order, are not always formed of bundles of the same row. Thus, in *Piper amplum*, I have ascertained that certain secondary veins appear tardily, and intercalate themselves with those formed first.

These secondary veins subsequently form part of a row of bundles more internal than the other. It may thus happen that veins, which appear to belong to the same order, and which are formed from above downwards—that is to say, parallel with each other, and ending in the same inferior vein—in reality form part of several different concentric rows, all formed from the front backwards, but my observations are not numerous enough to allow a positive assertion to this effect. It is, however, certain, that all the bundles of the young leaf are arranged in several rows encased in one another, and as the parenchyma dilates into the leaf-blade, or thickens in the petiole, these rows approach, and at last fuse together. There are, however, many fleshy leaf-blades, in which the division of the bundle in concentric rows is always visible, such as *Saxifraga crassifolia*, and *ligulata*, Figs. 14, 15. The last common bundles are often formed very long after the first, and constitute a manifestly inferior row, as in *Aralia digitata*, Fig. 16.

Every leaf contains a compound ligneous system composed of

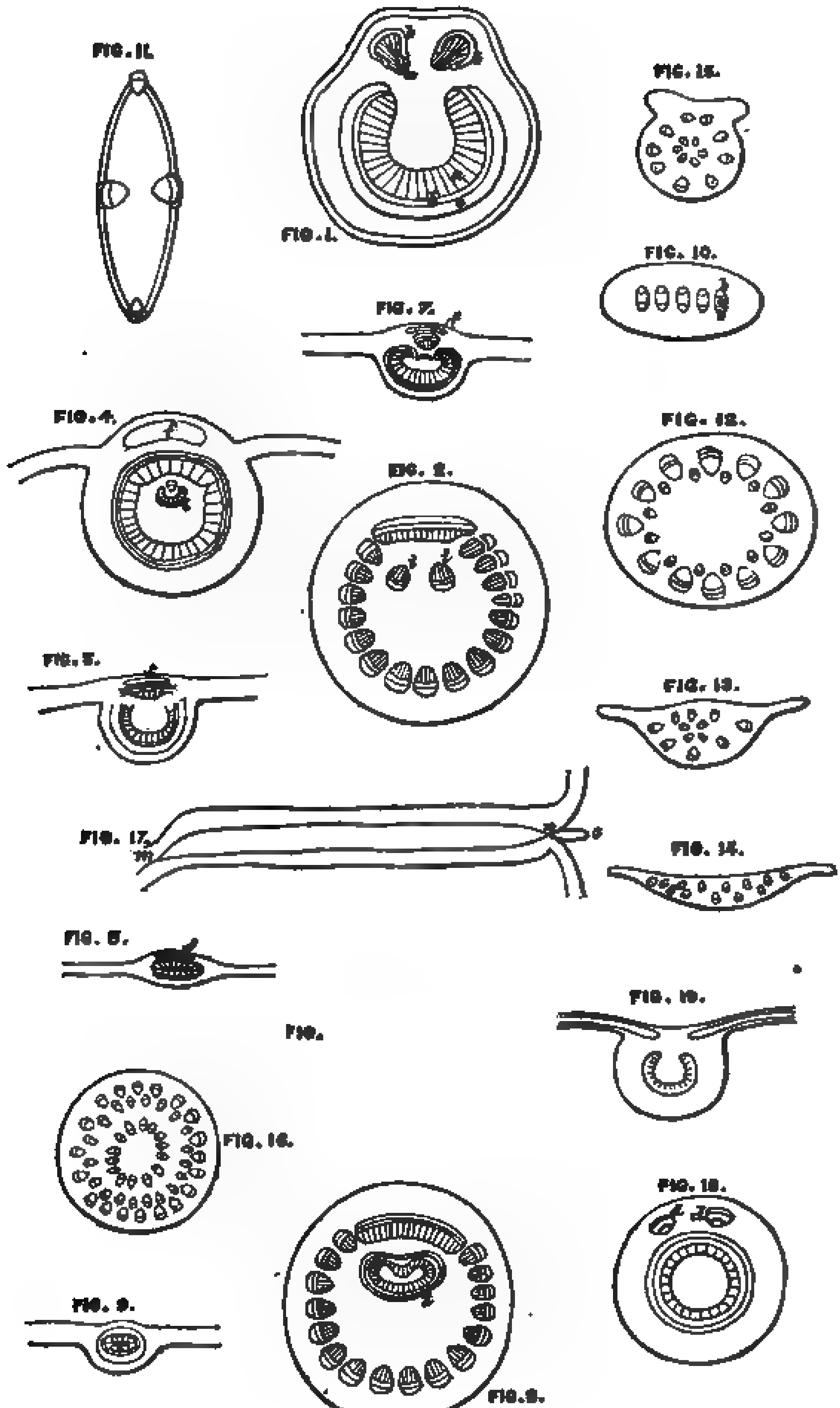


FIG. 11.
FIG. 1.
FIG. 15.
FIG. 10.
FIG. 7.
FIG. 4.
FIG. 2.
FIG. 12.
FIG. 3.
FIG. 13.
FIG. 17.
FIG. 14.
FIG. 5.
FIG. 19.
FIG.
FIG. 16.
FIG. 18.
FIG. 9.
FIG. 8.

bundles distributed in many rows (concentric in young leaves), occupying more or less of its circumference (*pourtour*), and all directed so that their cambium is turned towards the periphery of the leaf. This I call *the essential system,* to distinguish it from others hereafter mentioned. In the great majority of cases the essential system is continued; that is to say, the common bundles traverse the whole extent of the leaf, from the top of the leaf-blade to the stem. Sometimes it is interrupted at certain distances by nodes, in which a general anastomosis of all the bundles takes place, none of them extending throughout the leaf. These anastomoses of knots result like those of the network of leaf-veins, from a subsequent formation of bundles more internal, shorter, and uniting the common bundles which were at first independent. When we say a leaf has or has not these nodes, it should be understood of a leaf at its complete development. The presence or absence of nodes may be important enough to form the basis of a classification of leaves, and new terms would be required to designate them. Thus we might call *monomerous* leaves those in which the common bundles traverse entire the whole extent, from the border of the leaf-blade to the stem, or those which terminate in a node, below which the common bundles become perfectly distinct as far as the stem. *Polymerous* leaves are those in which the bundles anastomose once or more between their two extremities. The term *meriphyll* will designate the space between two nodes. Polymerous leaves may be *dimerous, trimerous,* etc., according to their number of meriphylls. They will be *uniaxifers, biaxifers,* etc., *multiaxifers,* according as their meriphylls are arranged along a single axis, or an axis ramified two, three, or more times. [Among monomerous leaves M. Cassimir de Candolle places *Mimosa pseudo-acacia, Cytisus laburnam,* the birches, poplars, etc., etc. The acacia, many begonias, and the Piperaceæ are *dimerous. Ricinus communis, Tropæolum majus, Aralia digitata,* and *Sieboldi* are *trimerous,* and *Thalictrum aquilægiæfolium, Aralia japonica,* and the Umbelliferæ are *polymerous* and *multiaxiferous* in his arrangement.]

These examples make us perceive the resemblance between the leaf and the branch. We see, in fact, that those plants in which the branch is divided by nodes or general anastomoses of ligneous bundles, are the only ones which produce polymerous leaves.

*   *   *   *   *   *

A third sort of bundles exists in a great many leaves, and I have named them *inverse bundles,* because their development is always centripetal. They are found in the interior of the medulla

of the essential system, and turn their cambium towards the middle of the leaf. Dr. A. Franck is, so far as I know, the only author who has noticed this, and he confines himself to mentioning their presence in *Acer pseudo-platanus* (sycamore), *Tilia microphyllia*, and *Quercus pedunculata*, without drawing any inference. [M. de Candolle proceeds to mention the same formation in a variety of other trees.] * * * *

We may consider all the bundles of a monomerous leaf, and each mériphyll of a polymerous one, as distributed in a series of formations one inside the other, and united by the parenchyma.

A leaf with a complete fibro-vascular system, will thus represent a branch the extremity of which died early, and in which the rows of bundles are indications of bunches of leaves the branch would have borne had it continued to live. If the parenchyma grows chiefly in a lateral direction, the branch flattens into a leaf-blade. If the parenchyma increases specially in the direction of a plane passing through the axis of the stem, the leaf takes the form of certain phyllodia, as in *Acacia ovalis*. If the parenchyma grows equally in all horizontal directions, the branch becomes a cylindrical leaf. We may even follow this analogy of the branch and the leaf into the smallest details. Thus, a leaf with an incomplete fibro-vascular system represents a branch of which the terminal cone remains more or less sterile over a zone, more or less extended from its summit and its posterior face. If the superior face had remained completely sterile, and if the parenchyma had grown principally in a lateral direction, it would have produced a leaf-blade with veins salient only on the anterior surface. If the sterility of the posterior surface does not affect the cortical system, the veins are salient on both sides, even though the ligneous system is not developed in the posterior region.

It might at first seem that this theory is in flagrant contradiction with the well ascertained basipetal formation of many foliary parts, but other facts of intimate structure conjoined with the doctrines of organogeny remove the difficulty.

In following the course of the bundles all along the peltate leaf of *Tropæolum majus* (Fig. 17), we find the first node above the insertion. Departing from this node, the bundles proceed onwards, independent, and parallel, to the summit of the petiole, when they anastomose a second time. From this second node the bundles which traverse the lower region of the leaf-blade diverge. On the other hand, by examining a longitudinal section passing by this, and by the petiole, we ascertain that other bundles rise up afresh above

the second node, and form the source of a new meriphyll, atrophied, and intercalated between the end of the petiole and the superior surface of the leaf-blade. The existence of this last meriphyll, which observation of the surface could not discover, plainly confirms the law of the formation of peltate leaves, as it is revealed to us by organogeny. It proves that the summit of the vegetable axis of the primordial leaf does not always coincide with the apparent summit of the leaf-blade—that is, with the point furthest removed from the base. These terminal atrophied meriphylls exist in other plants, and even in non-peltate leaves, such as *Aralia digitata*. It is easy to see the importance of this observation on the theory of leaves. The formation of certain parts, basipetal, in reference to the apparent base, may be basifugal in reference to the real summit of the vegetable axis and the primordial leaf. * * * * *

Primordial leaves are primordial offshoots (*saillies*) of the terminal cone, the auxiliary branches of which represent subsequent offshoots. Each primordial offshoot, or primordial leaf, can, in its turn, produce other offshoots, primary, secondary, tertiary, etc., sometimes throughout its circumference (*Acer pseudo-platanus, Populus nigra, Juglandceæ*, etc.), sometimes on one side only (as in most leaves). In the first case the vegetative summit of the primordial offshoot coincides with the apparent summit of the leaf (*Acer pseudo-platanus, Populus nigra*); but it may happen that the secondary offshoots elongate themselves more than those behind them, and convey the apparent vegetable summit beyond that of the primordial offshoot. (*Tropæolum majus, Saxifraga crassifolia, Saururus cernum.*) Thus in many leaves, the ligneous system, complete in the petiole, is entirely wanting in the posterior region of the leaf-blade (*Cytisus laburnam*, Figs. 18 and 19).

[M. Cassimir de Candolle proceeds to apply his theory to the explanation of the tube-calyx of the rose, and to the carpel of the magnolia. His theory of the leaf will, we doubt not, interest our microscopical readers who will take the trouble to make the sections necessary to follow his observations.]

WOMANKIND:

IN ALL AGES OF WESTERN EUROPE.

BY THOMAS WRIGHT, F.S.A.

CHAPTER IV.—(*Continued.*)

THE ANGLO-SAXON WOMEN.

When the clergy laboured to emancipate the female sex, they were certainly looking to their own interests. They had seen how the gentleness and pious spirit of the sex had assisted more than anything else in the early progress of Christianity. It was to Bertha, the Queen of Kent, that they owed the conversion of King Ethelbert, and to Ethelburga, that of Edwin, King of Northumbria. They sought, therefore, to substitute their own influence over Womankind for that of the family. The women were drawn away from earthly marriages to be, as they expressed it, married to Christ; that is, to enter the monasteries, and become nuns. The religious houses were thus filled with women who had either separated from their husbands, or refused to accept the husbands designed for them by their fathers, usually under the protection, if not under the encouragement, of the ecclesiastics. In the pagan Saxon period it appears that a man could divorce himself almost at pleasure; and if he and his wife agreed to separate, each was at liberty to marry again, without publicly assigning any cause for their separation. After the establishment of Christianity, the bishops assumed the right, not only of giving their sanction to such divorce or separation, but of annulling a marriage at their own will for any cause they chose to assign. It appears that, even during the seventh century, a very small cause of dissatisfaction on the part of the husband was considered a sufficient reason for putting away his wife. The primitive Anglo-Saxon notion of divorce, as it will be seen, was simply repudiation, and the practice of this was gradually wearing out during the seventh century, and in its place the clergy permitted these separations by mutual consent.

There are sufficient reasons for believing that these assumptions of the clergy to interfere in the domestic relations of the family were never liked by the Anglo-Saxon laity, and that those who had the power frequently set them at defiance. They were, indeed, carried to a degree which made them often extremely burthensome,

and in some cases quite unbearable. They had introduced a scale of consanguinity—within which marriage was not permitted—so ridiculously wide, that it was not easy to be sure whether you were within its limits or not, and thus provided themselves with an excuse for interfering almost whenever they liked. According to the Anglo-Saxon ecclesiastical laws, it was unlawful to marry within the fifth degree of consanguinity. How the power thus acquired by the clergy could be abused is shown in the treatment of Elfgiva, the beautiful queen of Edwy, by his ministers, archbishop Odo and the imperious Dunstan. Elgiva is said to have been related to him within the prohibited degrees, but it is not clear how. At the feast which followed the coronation, several days, as was the custom, were devoted to feasting and drinking, and on one of these the king, weary of the revelling, absented himself from the drinking hall, and repaired to the chamber of his bride. When his absence was discovered it was taken as an insult to the company, and Dunstan, then Abbot of Glastonbury, with Kinsey, Bishop of Lichfield, were sent in search of him. Bursting rudely into the queen's chamber, they found the king fondling with his wife, in the presence of her mother. They insulted both mother and daughter with the grossest imputations, and, seizing the young king, they dragged him violently along the passage back into the hall. Elfgiva, in her resentment, joined the party of the nobles, and of the old and more national clergy, who were resisting the encroachments of the ecclesiastical power, and by whose temporary influence Dunstan was soon afterwards sent into banishment. The queen thus became an object of hatred to the monastic party, and Archbishop Odo, who was now their leader, avenged them by persecuting the queen. Two years after the occurrences just related, Odo, having obtained the approval of the Pope, pronounced that the marriage of Edwy and Elfgiva was unlawful, because within the prohibited degrees of kindred, and annulled it. The king might have resisted this act of tyranny, and he would, no doubt, have been supported by his people. So Archbishop Odo sent a strong party of his retainers unexpectedly, who carried off the queen, seared her face and lips with red-hot irons, in the hope of destroying her beauty, in which they supposed that her influence over the King resided, and then sent her to Ireland, probably as a slave. She remained in Ireland a short time, until the scars on her face were so far healed that she had recovered much of her beauty, and then she made her escape, and crossed over to Gloucester. But she was discovered there by Odo's agents, who caused her to be disabled from wandering

further by severing the sinews of her legs, and committed such injuries on her person that she died a few days afterwards.

It is difficult to estimate the exact result of the influence of the establishment of monasticism upon the character and position of Womankind in Saxon England. The Anglo-Saxon clergy of the older schools shared in the domestic sentiments of the laity, and it was not considered to be inconsistent with their profession, any more than in Protestant England, to have wives and children. In the earlier monasteries the two sexes lived together in the same building, though they were bound to strict continence and chastity. Corruption, however, soon introduced itself, and the character of the inmates of the religious houses became more and more secular. With the latter part of the eighth century the Anglo-Saxon nuns became proverbially dissolute in their character, and from this time forward the Anglo-Saxon kings sometimes took their wives, and very frequently their mistresses, from the convent. The monastery certainly did not improve the moral character of Womankind. It became the practice for men of wealth to found a monastery, and endow it with their broad lands, and to introduce into it a number of their retainers and friends, in the garb (but with no other qualification) of monks, in order to live luxuriously and at their ease, and escape the duties and troubles of secular life. The great ecclesiastics, both here and on the continent, while they inveighed loudly against the love of the laity for finery, displayed an extravagant passion for dress themselves. To illustrate this fact, I need only give the description of the costume of the lady abbess of one convent in the words of Mr. Thrupp.* "She appeared," he tells us, "in a scarlet tunic, with full skirts and wide sleeves and hood, over an under vest of fine linen of a violet colour, with shoes of red leather. Her face was rouged, and her hair curled with irons over the forehead and temples; ornaments of gold encircled her neck; heavy bracelets adorned her arms; and jewelled rings were upon her fingers. Her nails were worn long, and cut to a sharp point, to resemble the talons of a hawk." Odo and Dunstan represented the new ecclesiastical party, who were labouring to reform monachism in England, by introducing the Benedictine order and stricter Romanism.

There appears to have been more of gentleness and of the domestic spirit in the Anglo-Saxon race than in that of the Franks. The women of the former appear in a brighter light, and seldom as the authors of frightful crimes, such as those perpetrated by a Fre-

* "The Anglo-Saxon Home," p. 231.

degonde or a Brunehild. We can gather only two such examples as standing prominent in our history—that of Eadburga, daughter of the great Offa, King of the Mercians; and that of Elfthrida, the wife of King Edgar; the latter celebrated in the Anglo-Saxon annals as the heartless murderess of her stepson, Edward the Martyr. The daughter of Offa was married to Bertric, King of the West Saxons; and, contrary to what appears to have been the usual custom of the Anglo-Saxons, she was enthroned by his side and crowned. According to the national feelings, she would be considered only as the king's wife, just like the consort of any other chieftain. This distinction arose probably from the extraordinary influence she had gained over Bertric's mind, which was seldom exercised for good. According to William of Malmesbury, it was her custom to rid herself by poison of all persons at court who rose independently into the king's favour, or who stood in her way. A young noble, named Worr, high in birth and character, and popular on account of his good qualities, had become a great favourite with King Bertric, and, therefore, an object of hatred to his queen. Eadburga, according to her usual practice, prepared a poisoned cup, of which, by accident, the king as well as his favourite partook, and both perished. The West-Saxons, in their indignation, drove the murderess into banishment, and resolved that in future no wife of a king should ever be throned beside her husband, or bear the title of queen. After this, the king's wife bore the simple title of "The Lady." Eadburga, with her treasures, fled to the land of the Franks, and presented herself at the court of Charlemagne, who, knowing she wanted a husband, and being at that moment desirous of providing an excuse for carrying out designs he had of aggrandisement in England, offered her the choice of himself or his son. Eadburga replied that she preferred youth to age. The great emperor, disgusted with her levity, replied that she should have neither; and, as he knew she was a wicked woman, he made her the abbess of a rich monastery. It appears that, at this period, the morality of monastic life was at as low an ebb among the Franks as among the Anglo-Saxons. Eadburga exercised her duties of abbess for a short time, until her low amours became so notorious that the emperor ordered her to be expelled from the convent. She went into Italy, accompanied by one slave; and the daughter of one great monarch, and wife of another king, died in beggary in the city of Pavia. To these we may perhaps add Cynedreda, the wife of King Offa, and mother of Eadburga, who was accused—it may be unjustly—of the murder of Ethelbert, King of the East Angles, over whose

bones was raised the stately cathedral of Hereford; and one or two others, whose crimes seem equally doubtful.

Against these we may place a far larger number of names which appear in history in a light honourable to Womankind. Such was Ethelburga, the queen of Ina, of Wessex; and that other Ethelburga, through whose gentle influence over her husband the Northumbrians were converted to the gospel. Such, as far as we can understand her character, was the noble Sexburga, of Wessex—the only Anglo-Saxon lady who has left us the example of a reigning queen. Such, too, was Elfgiva, the mother of King Edgar, who was made a saint for her virtues. Such, truly, was the noble Ethelfleda, who was known to her admiring countrymen as "The Lady of the Mercians." Such was Edith, the daughter of Earl Godwin, and the wife of King Edward the Confessor—distinguished equally for her beauty, her piety, and her learning—for learning was looked upon as an accomplishment in Anglo-Saxon ladies. The account of his interview with her in his boyhood, given by the monk Ingulf, presents an agreeable picture of the homely and gentle character of the Anglo-Saxon queen. "I saw her often," he says, "when, still a boy, I visited my father, who was dwelling in the king's court; and very often, when I met her as I was coming from school, she questioned me in my grammar and verses, and, most readily passing from the solidity of grammar to the lightness of logic, in which she was skilful, she would confute me with the subtle threads of her arguments; always, after counting out to me by her handmaid three or four coins, she sent me to the royal larder, and dismissed me after I had taken refreshment."* I am a disbeliever in the authenticity of the History which goes under the name of Ingulf; but it may have been partly founded upon traditions and records which were preserved at Croyland as late as the beginning of the fourteenth century, and I confess that the story of Ingulf's boyish intercourse with Queen Edith sounds more like an Anglo-Saxon truth than an Anglo-Norman invention. We might add to the names given above, that of Godiva, another lady of Mercia—the heroine of Coventry legend; and a multitude of other equally bright examples of Anglo-Saxon Womankind. Some of the finer

* "Vidi ego illam multotiens, cum patrem meum in regis curia morantem adhuc puer inviserem, et sæpius mihi de scholis venienti de literis ac versu meo apponebat cum occurrerem, et libentissime de grammatica soliditate ad logicam levitatem qua callebat declinans, cum argumentorum subtili ligamine me conclusisset, semper tribus aut quatuor nummis per ancillulam numeratis ad regium penu transmisit et refectum dismisit." —Ingulfi Historia, in Gale's "Rerum Anglicarum Scriptores," vol. i., p. 62.

features of Anglo-Saxon womanhood in the earlier part of the eighth century, are shown in the correspondence of Boniface, and especially in the letters between him and his principal female correspondent, the Princess Eadburga, or, as she is more frequently called, Bugga, a bye-name which means simply the Bug, and which can hardly have been complimentary to her personal appearance. These bye-names, or nick-names, were common among the Anglo-Saxons, and people were not only more commonly addressed by them than by their proper names, but they sometimes used them in signing charters.

It may be remarked, on this question of names, that the names given to girls at their baptism almost all marked the appreciation of the Anglo-Saxons for gentleness and goodness in the female sex, for they were all founded upon the expectations or hopes of the parents as to the future character of their offspring. Thus, of the names I have just introduced to the reader, Eadburga means the citadel or mansion of happiness; Ethelburga, the citadel of nobility; Ethelfleda, the flood or stream of nobility; Edith (Eadgyth) the gift of happiness, or the happy gift; Elfgiva, the gift of the elves, or fairies, or the spiritual gift; Elfthrida, the strength of the elves, or spiritual strength; Godiva (Godgifu) the gift of God, or the divine gift. It was very common among our forefathers of this period to give to their daughters names compounded of the word elf, or fairy, both to indicate the great qualities they hoped that they would possess, and perhaps also with the feeling of placing them under the protection of the spiritual world.

It is among the illuminations of the Anglo-Saxon manuscripts that we first see woman on horseback. Riding appears never to have been a favourite practice with either sex among our Anglo-Saxon forefathers. It was long the opinion of our writers on costume and domestic manners, founded on a statement of an old writer not deserving of much credit, that until the closing years of the fourteenth century (the reign of Richard II.), women invariably rode astride, like men, and our first example might seem to favour this belief. It is taken from a finely-illuminated manuscript of the "Psychomachia" of Prudentius (MS. Cotton., Cleopatra C. VIII. fol. 10, v°). The equestrian, in this case, is the Lady Pride. She is represented in the poem of Prudentius as engaged in combat with her enemy Humility, and dashing through the routed troops of her foes on an unbridled horse, its back and shoulders covered with the skin of a lion. Seated on this, she looks down with scorn on the hostile troops. She has collected her plaited locks on her head in

the form of a lofty tower, so that together they might increase the building of curls, and the forehead support the lofty peak. A mantle

PRIDE ON HORSEBACK.

(*palla*) of fine linen from the shoulders is joined at the top of the bosom, fastened over the breast by an elegant knot. A veil, surrounded by a delicate fringe, flowing from the head, receives the breeze thrown into it with swelling folds.

> "Forte per effusas inflata Superbia turmas
> Effreni volitabat equo, quem pelle leonis
> Texerat, et validos villis oneraverat armos
> Quo se fulta jubis jactantius illa ferinis
> Inferret, tumido despectans agmina fastu.
> Turritum tortis caput accumularat in altum
> Crinibus, exstructos augeret ut addita cirros
> Congeries, celsumque apicem frons ardua ferret.
> Carbasea ex humeris summo collecta coibat
> Palla sinu, teretem nectens a pectore nodum.
> A cervice fluens tenui velamine limbus
> Concipit ingestas textis turgentibus auras.
> Nec minus instabili sonipes feritate superbit,
> Impatiens madidis frenarier ora lupatis."
>
> Prudentii "Psychomachia," l. 170.

The Anglo-Saxon artist has attempted, in the above figure, to give a pictorial explanation of the above lines, not, I fear, very successfully in its details. The Lady Pride (*Superbia* in Prudentius —in the Anglo-Saxon gloss, *seo Ofermodnes*, literally, high-mindedness) is so in temper, but not in garb. She is bare-legged and bare-footed. The draughtsman was so used to depicting ladies

with the head-rail, that he has not attempted the head-dress as described in the original. The *palla,* or mantle, is spreading itself out to the winds in a very wild manner. We can trace, in the remainder of the dress, two articles, either the chemise and the tunic, or the outer and inner tunic.

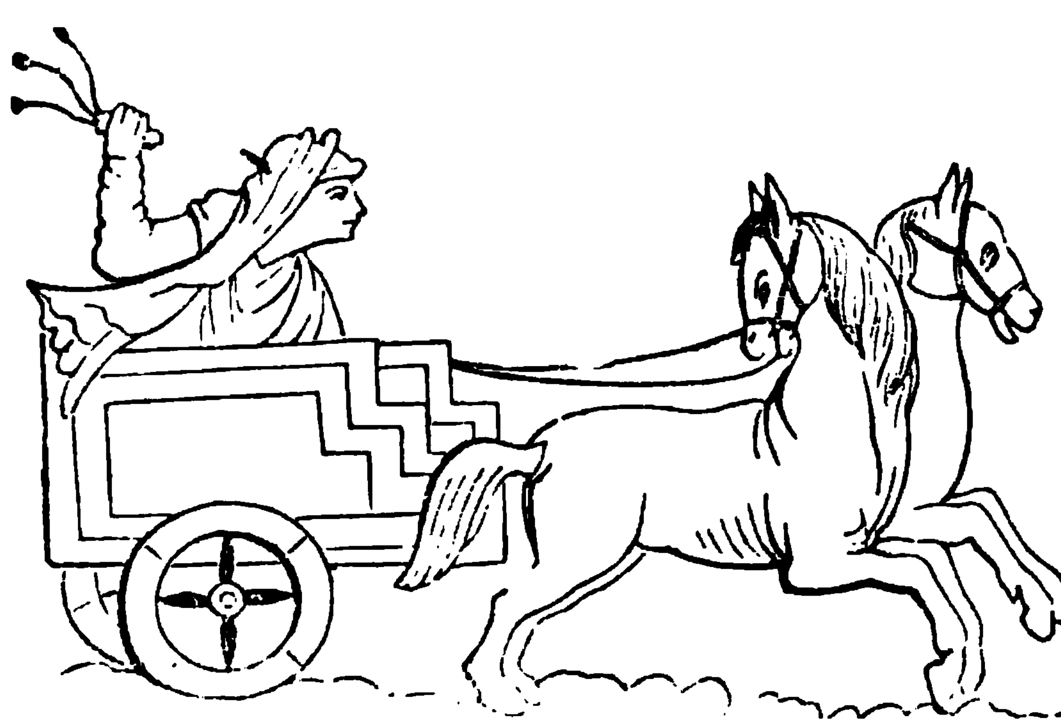
The position of Lady Pride on her horse is certainly an exceptional one, and is not in accordance with other Anglo-Saxon monuments. In our next cut, taken from Archbishop Alfric's translation of the Pentateuch (MS. Cotton, Claudius, B. IV.), the manner of sitting on horseback of either sex is clearly defined, though the lady sits, according to our modern notions, on the wrong side of the horse, so that she has her left hand to the bridle, while in her right she holds a whip of rather remarkable character. It may well be described, in the words of the Dictionary, as "a whip, or *scourge.*" The book of Genesis (chap. xxxi., verse 17) tells us how Jacob,

A GENTLEMAN AND LADY ON HORSEBACK.

JACOB'S FAMILY RIDING ON CAMELS.

when he removed into the land of Canaan, "rose up, and set his

sons and his wives upon camels." The illuminator of the Cottonian manuscript of Alfric's translation (MS. Cotton, Claudius, B. IV., fol. 47, r°) has endeavoured to represent this scene in a group, some figures of which are given in the annexed cut. The knowledge of the camel displayed by the Anglo-Saxon artist is not great. His women are riding exactly in the same position as in the foregoing cut of the lady on horseback, and sit in the same manner on the wrong side of the beast. The reason, perhaps, may be, that the custom of riding on horseback was so rare in England, that he was obliged to draw upon his imagination. How his ladies held their seats it would not be easy to explain. The manuscript of Prudentius, from which we have borrowed so many of our illustrations (MS. Cotton, Cleopatra, C.VIII.), gives a representation of a



A LADY CHARIOTEER.

lady driving in a chariot, which we reproduce in our last cut. It is drawn by two horses, and the lady is armed with the same formidable description of whip which we have met with before. The Anglo-Saxons had two names for a chariot, both which rather intimate the homeliness of its character. One was *wægn,* or *wæn,* the modern word waggon; the other *cræt,* or *crat,* which is our modern word cart. The chariot here represented is not unlike a market-cart.

ON THE ZOETROPE AND ITS ANTECEDENTS.

BY WILLIAM B. CARPENTER, M.D.,

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(*Continued from* Vol. i., p. 444.)

THE publication of Professor Faraday's experiments excited considerable interest among Continental *savans;* and Professor Plateau, of Liège, whilst fairly claiming priority in the observation of the stationary spectrum given by two cog-wheels revolving in opposite directions, gave to Professor Faraday the entire credit of the discovery of that seen in the mirror when the image of the single wheel is looked at through its own cogs. It very soon occurred to him to vary the illusion, by substituting for the *repetition of similar impressions* given by the ordinary cog or spoke-wheels, a series of *gradationally varied impressions,* produced by figures of the same object in different positions. This idea was very readily carried out by drawing a circular series of such figures on the inner part of a disk, and looking at their reflection in a mirror through holes cut in the outer part of the same disk; to which contrivance he gave the name of *Phenakisticope.*

The same idea seems to have suggested itself independently to Professor Stampfer, of Vienna, who almost simultaneously brought out a similar invention under the name of the *Stroboscope;* and it is from one of his disks that our Fig. 4 has been reduced, as a very characteristic illustration of the interesting and varied class of phenomena thus producible. The central portion of this disk is occupied by a large cog-wheel having *eleven* radii; and as the number of holes through which it is viewed is *ten,* the spectrum of this wheel seems to be in slow revolution in the direction of the actual revolution. Round this central wheel are disposed ten smaller wheels: and these also seem to be in revolution, but through an entirely different agency. For if these wheels were all precise repetitions of one another, their spectra would appear stationary; and the appearance of rotation is given by the disposition of their radii, which will be observed to differ as we go from any one wheel to the next, so that each as it passes the eye appears to have moved a little round its own centre, and thus the effect of continuous rotation is given to every one of the spectral series. Each wheel is connected, by a lever attached to one of its radii, with a hammer working on a

pivot; and by the different positions in which the ten hammers are represented, the action of rising and falling is given to them,—the rise, however, being gradual and the fall sudden. The manner in which this last effect is produced will be understood from an examination of the relative positions of the hammers as we pass round the circle; for, commencing with the one (to the left of the highest hole in the edge of the disk) which is resting on the anvil, and following the series round the circle in a direction opposite to that of the hands of a watch, we see that each hammer rises progressively, until the highest point is reached in the one next to that with which we began; so that there will pass before the eye ten consecutive images, showing a progressive rise of the hammer, to be succeeded by an image in which there is a sudden return to the lowest point.

All the devices by which motion is given to the spectra in the Phenakisticope and Stroboscope are constructed upon these two principles; movements of *translation*, forwards or backwards, being determined by a difference between the number of figures disposed in circular series and the number of slits through which they are viewed; and movements *in the parts of figures* being produced by varying the disposition of those parts, either gradationally or interruptedly, as the effect may require.

For the best exhibition of all the effects of this class, it is desirable that the slits through which we look should be narrow, since it is by this means that the spectrum is presented with its greatest distinctness, as already pointed out in the account of Dr. Roget's experiments (Vol. i., p. 432); for if the slits be as wide as the intervals between them, we see so much of the rotatory movement of each figure as it passes the eye, that the spectrum is rendered hazy like that of the cog-wheel shown in Fig. 7; whereas, by narrowing them as much as we can without shutting off the view we have to gain through them, we limit our glimpse of each figure to that *momentary* glance in which it is practically almost stationary.

It is a very curious feature in all these illusions, that the effect produced upon the consciousness by the succession of gradationally varying images, is that of uninterrupted movement, except in cases in which the reverse is intended; the passage between each visual impression and the next being *smoothed over* (so to speak) *by the mind*, which itself completes the conception of continuous movement, that is only *suggested* by the succession of separate dissimilar impressions. This principle is admirably illustrated by a little

apparatus lately shown to the writer by Sir Charles Wheatstone, who devised it for the purpose of exhibiting the effects produced by the Phenakisticope and Stroboscope in such a manner as to indicate their true *rationale*. It consists of a disk of card, near the circumference of which are painted at regular intervals a series of black figures representing a man with his limbs in different attitudes; each figure being intermediate in position between the figures on either side of it. This disk is made to revolve, by means of a cog-wheel acting on a "snail," not continuously, but in a series of interrupted jerks; the movement being so arranged that by each jerk the disk is advanced very quickly through the interval between one figure and the next, whilst it remains stationary for an appreciable time between each translation. Hence, if the eyes be fixed, without any intermediate apparatus whatever, on some one part of the disk, and the wheel be made to revolve in the manner above described, each figure, as it comes to a momentary stop, makes its own visual impression, which remains so distinct that the succession is scarcely impaired by the rapid intervening movement of translation; and thus if the figures were all similar, that succession would produce the mental image of the wheel with its circle of figures at absolute rest. But as the attitude of each figure which passes before the spot at which we are looking, differs from that of the figure which preceded it, we see on the spot at which we gaze, not a series of similar figures, but a succession of dissimilar figures; and thus, when the disk is made to revolve with a certain degree of rapidity, that spot seems to be occupied by a figure, of which the limbs are in continual movement. This movement, however, is not in a series of jerks, as might have been anticipated from the interruptedness of the sequence of the visual impressions on which the appearance depends, but seems to be as continuous as it would be in nature; and this apparent continuity can only be explained by attributing it to a *mental filling-up* of the intervals between the images actually received through the visual sense, converting (so to speak) a series of steps into a smooth incline.

This mental action becomes very perceptible, when we study the illusions exhibited by the *Zoetrope*, with sufficient care to distinguish between the *actual impressions* which we receive through our sight, and the *notions* which those impressions suggest.

This instrument differs from its predecessors merely in this—that instead of looking at one revolving disk through slits in another, or looking through slits in a disk at its image reflected in a mirror, we look through slits in the side of a vertical revolving

drum at the interior of the opposite side of that drum, which moves, of course, in a direction opposite to that of the side next the eye, and with precisely the same velocity. If, when we cause the drum to revolve with considerable quickness, we look *over its edge* at the slits on the opposite side, these appear so blended by the motion as to be indistinguishable; but if we look at them through any of the slits on the side next us, a spectrum of the opposite inner side is seen, with its slits very clearly defined and at perfect rest. This is precisely what might be anticipated from all that has gone before. And when one of the long strips covered with figures is placed in the lower part of the drum, and is viewed through the slits in its near side, the effect is exactly the same as that produced by looking through the slits near the margin of the disks of the Phenakistiscope or Stroboscope, at the reflected images of the figures which are circularly disposed within. The Zoetrope has the double advantage of enabling a large number of spectators to witness its curious effects at the same time; and of serving for the ready exhibition of any number of different designs, which are printed on long strips of stiff paper (the length of each being adjusted to that of the internal circumference of the drum), so that one can be easily substituted for another.

Now, if these designs be examined, it will be found that the movements which they represent all depend upon two conditions—the movements of *translation*, in which the figures appear to pass onwards or backwards round the interior of the drum, being all due to the numerical relation between the *figures* and the *slits*; while the changes in the *positions* of the figures, which may or may not be combined with a movement of translation, depend upon the relations between the parts of those figures as we follow them from one end of the strip to the other, these relations being so adjusted in the drawing as to produce the effect either of continuous or of interrupted or reversed movement, as the subject may require. Thus if we compare the "Wild Irishman" (No. 3) with "Paddy at Donnybrook" (No. 10), we shall see that in the former, which shows no movement of translation, the number of figures is *thirteen*, which is the same as that of the slits; and that the apparent movements of the limbs depend entirely upon the changes in their relative positions in the consecutive figures; whilst in the latter, the number of figures being only *twelve*, the figures have an apparent motion round the drum, in a direction opposite to that of their real motion (as in the case already explained), the positions of the limbs in the consecutive figures being so adjusted as to

correspond with the successive attitudes of a man running and flourishing his shilleghlah.

So, again, if we compare "Football" (No. 9) with "Nobody's Little Game" (No. 12), we see that in the former, which represents a man lying on his back and making a ball revolve on his uplifted feet, there is no movement of translation, because the numbers alike of the figure and the ball are equal to that of the slits, whilst the effect of revolution is given to the ball by differences in the position of the green band which crosses it (as in Fig. 6), and the appropriate motion is given to the legs of the figure by the variation of their position in the successive presentations of it; in the latter, on the other hand, the "Nobodies" are represented as kicking the ball from one to the other, the balls at the same time rising and falling in the air, moving on their axes, and having a movement of translation in the opposite direction to their actual movement, their number being *twelve*, as in the preceding case. The suddenness of the jerk of the ball upwards, contrasted with the uniformity of its onward progress and descent, is admirably represented, on the same principle with the fall of the hammers already explained (p. 24); and the movements of the limbs by which this jerk is apparently produced, depend upon relations between their positions in the consecutive figures, which need to be carefully devised to produce the very unevenness that shall suggest the effect. In "Warm Work for Blackey" (No. 20) again, we have a ball which rolls forwards on the ground, the effect of revolution being given, as before, by consecutive variations in the position of the green band which crosses it, whilst the movement of forward translation is produced by the increase in the number of figures of the ball to *fourteen*. On the other hand, the figure of "Blackey" is made to jump backwards from one ball to another; its movement of backward translation being due to the reduction in the number of repetitions to *twelve*, while with this is combined a set of corresponding movements in the figure itself, which depend as before upon consecutive variations in its position. The same combinations are presented in "The Red-legged Ogre and his Dancing Poodle" (No. 24), with the addition of a stationary hoop through which the dog seems to jump in one direction, whilst the ogre walks beneath the hoops in the contrary direction;—these diversities exactly corresponding with that already described in the spectrum of the wheel with three sets of slits, when the image was looked at through the intervening series (Vol. i., p. 444); for the number of hoops being *thirteen* is equal to that of the slits, so as to produce a stationary spectrum, the number of poodles being *fourteen*,

their spectrum has a movement of onward translation, and the number of ogres being *twelve*, their spectrum has a movement of backward translation.

The *mental filling-up*, which performs an important part in the illusion, is particularly obvious in the *perfect continuity* apparent in the motion of the rolling ball, as regards both its onward translation and its revolution on its axis; for both these effects being due to the reception of a succession of glimpses of the object in different positions, the apparent evenness of the motion can be produced by nothing else than a mental combination of the separate impressions into a notion of the object in continuous and uniform movement.

This effect is also extremely remarkable in the wonderfully regular movements exhibited by the "Fish and Fowl" (No. 11), the continuous tumbling of the porpoise, and the heavy undulating action of the wings of the gull, being represented with marvellous truth to Nature, by variations in the position of the consecutive figures that are skilfully devised to *suggest* the appropriate action in each case. The help thus given by the mind becomes particularly obvious when we examine "Such a Getting Up of Stairs" (No. 16), in which a monkey seems to ascend by successive steps a ladder placed against the head of a stationary figure, and then to jump from its top to the ground; for one would be almost ready to swear that he can distinguish the motion of the legs of the monkey, as he climbs every rung of the ladder; and yet a comparison of the consecutive figures proves that such cannot be the case, the intervals between the actual positions being such as to leave considerable gaps to be mentally supplied. The same is true of the "Indian Juggler," keeping up three balls whilst himself standing on a large ball, which he keeps in revolution beneath his feet, as shown in Fig. 6.

The large share which the mind may take, becomes peculiarly

evident when we compare the mental conception given by "Base Ball" (No. 6) with the visual materials which suggest it. We here see the upper halves of a figure, seated as it were in a gallery which cuts off its lower halves; by an apparent movement of its arm one ball seems to be thrown from its hand after another; and the balls appear to roll down an inclined plane towards the spectator. Now, whilst the appearances of the dropping of the balls, their descent, and their revolution, are produced by the means already explained, the notion of their approach towards the spectator as they fall is entirely due to the *suggestion* conveyed by a consecutive increase in the actual sizes of the figures of the balls as they approach the bottom, corresponding with the suggestion of approach of the object that is given by the increase in the size of its image in the Phantasmagoria. And it is not a little curious that, whilst this notion does not always spontaneously occur to those who look at the picture for the first time, it seems uniformly to *recur* when it has been once suggested; the observer even coming to wonder that it did not so strike him in the first instance.

Thus we see that the interest which this class of "philosophical toys" has for the scientific investigator, is not limited to the determination of the cause of the *optical* deception that constitutes their most obvious feature, but extends into the higher and less familiar region of *psychological* inquiry. The distinction between *what we actually see* and our *notion of what we see* is so commonly lost sight of, that the want of it is one of the most fertile sources of human error; hence the importance of recognizing it cannot be too strongly insisted on. Believing, as the writer does, that the best corrective of this deficiency is to be found in the early cultivation of *a scientific habit of thought*, it has been his aim to utilize the general interest excited by the introduction of the Zoetrope, not merely for the purpose of informing his readers as to the history of its invention and the principles of its action, but also to show them what valuable lessons may be drawn from the intelligent study of phenomena which are viewed, in the first instance, as subjects of amusement only. For this study, carefully pursued step by step through various developments of a very simple and intelligible principle, is of itself a valuable exercise in scientific thought; whilst a higher meaning than could have been anticipated in the first instance, is found in that final comparison between *apparent* and *the real*, which shows how large a share in the production of the moving images seen with the *eye of the mind*, is due to the interpretation which our previous

experience leads us to put on the impressions actually received through our *visual sense.* How much this is the case, even in the commonest matters, is known only to the few who have made a special study of the subject.

(*To be Continued.*)

ON THE NEW THEORIES IN CHEMISTRY.

BY F. S. BARFF, M.A. CANTAB., F.C.S.,

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No. V.

When methylic alcohol CH_4O is made to react on sulphovinic acid, methyl takes the place of the typical hydrogen and vino-methylic ether is produced.

$$\begin{matrix}C_2H_5\\H\end{matrix}SO_4 + \begin{matrix}CH_3\\H\end{matrix}O = \begin{matrix}C\,H_3\\C_2H_5\end{matrix}O + \begin{matrix}H\\H\end{matrix}SO_4.$$

If now methylic alcohol be gradually poured into the retort in which the process of etherification is being carried on, the next reaction will be as follows:—

$$\begin{matrix}CH_3\\H\end{matrix}O + \begin{matrix}H\\H\end{matrix}SO_4 = \begin{matrix}CH_3\\H\end{matrix}SO_4 + \begin{matrix}H\\H\end{matrix}O;$$

and this sulpho-methylic acid will react on more methylic alcohol—

$$\begin{matrix}CH_3\\H\end{matrix}SO_4 + \begin{matrix}CH_3\\H\end{matrix}O = \begin{matrix}CH_3\\CH_3\end{matrix}O + \begin{matrix}H\\H\end{matrix}SO_4.$$

So that, at the end of the operation, the sulphovinic acid employed in making vinic ether is not the same as was produced at first, for, when another alcohol is brought to act on the sulphovinic acid, the radical of the new alcohol first forms with the ethyl of the sulphovinic acid a compound ether, and afterwards its ether only is formed. This etherification process, therefore, consists of a series of double decompositions which are analogous to those which take place when ether is formed by the action of the iodide of an alcohol radical on an alcohol, or when sulphuric acid reacts on hydrated oxide of potassium, as has already been shown. The reasons, therefore, which lead to doubling the atomic weight of oxygen received confirmation from these processes and reactions which we have just

been considering, for there is a perfect analogy between the formation of the following compounds—

$$\begin{matrix} H \\ K \end{matrix} O \quad \begin{matrix} CH_3 \\ K \end{matrix} O \quad \begin{matrix} C_2H_5 \\ K \end{matrix} O.$$

and the arguments used to show that $\begin{matrix} H \\ K \end{matrix} O$ and not $\begin{matrix} H \\ K \end{matrix} O_2$ is the correct formula for potassic hydrate, are equally applicable in the case of potassic ethylate and methylate, as well as to the formulæ for the ethers simple or compound—

$$\begin{matrix} K \\ K \end{matrix} O \quad \begin{matrix} CH_3 \\ CH_3 \end{matrix} O \quad \begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix} O \quad \begin{matrix} C_2H_5 \\ C\,H_3 \end{matrix} O.$$

For there is in the molecule of ether, occupying in a state of vapour two volumes, the same amount of oxygen as in molecule of alcohol, which also occupies two volumes, and as alcohol has been shown to be water, in which one atom of hydrogen has been replaced by ethyl C_2H_5, and as ether is likewise water in which both atoms of hydrogen have been replaced by ethyl (and these replacements take place in successive stages), it is clear that the oxygen is an atom and not divisible, but that the hydrogen is, and therefore the atomic weight of oxygen must be sixteen, and not eight, that of hydrogen being one. And the molecular formula of ether must be double what it was represented to be under the old system. That is, using the old atomic weights, it must be $C_8H_{10}O_2$, and not C_4H_5O, as it was believed to be when alcohol was regarded as ether plus water, and was expressed by the formula $C_4H_6O_2$.

The presence of oxygen, or of a chlorous element or compound like oxygen, in the radical of a salt is known to confer on it acid properties, and these properties seem to increase in proportion to the increase of the chlorous constituent. If alcohol be oxidised, one of the products of its oxidation is acetic acid, which is formed by the substitution of oxygen for hydrogen, accompanied by the simultaneous production of water. Now, in the molecule of alcohol there are six atoms of hydrogen, and it is of importance to determine which of these atoms are replaced by hydrogen. Acetic acid, like alcohol, has monobasic properties, and that hydrogen which in alcohol is replaceable by metals, must remain so in acetic acid, supposing acetic acid to be formed from alcohol, which experiment proves it is, and this hydrogen belongs to the type; it is the hydrogen of the water not already replaced by ethyl, oxygen does not take the place of this, but of some of the hydrogen in the radical ethyl, so that if one atom of oxygen be subsituted for two

atoms of hydrogen in ethyl, $C_2\ H_5$, we get $C_2\ H_3\ O$, and this oxidised radical, called by Dr. Williamson othyl, or oxygen ethyl, is the radical of acetic acid. For the experiments confirmatory of this view the reader is referred to Dr. Williamson's paper "On Etherification," published in the Journal of the Chemical Society.* So that acetic acid is represented on the type of a molecule of water, thus—

$$\begin{matrix} C_2\ H_3\ O \\ H \end{matrix} O$$

All bodies, therefore, which can produce similar reactions may be considered as being formed on the same type, and the number of atoms of oxygen in the radical shows the basicity of the acid, that is, how much hydrogen it contains which can be replaced. In acetic acid there is one atom of oxygen in the radical, and one basic hydrogen, and only one potassium salt is known, $\begin{matrix} C_2\ H_3 \\ K \end{matrix} O$. Oxalic acid is dibasic, and has two atoms of oxygen in its radical, $\begin{matrix} C_2\ O_2 \\ H_2 \end{matrix} O$, and two atoms of hydrogen, which can be replaced by potassium, thus, $\begin{matrix} C_2\ O_2 \\ KH \end{matrix} O_2$, and $\begin{matrix} C_2\ O_2 \\ K_2 \end{matrix} O_2$; it also forms two ethers and two amides. There are also tribasic acids, as malic; and tetra-basic, as tartaric. Certain compounds are regarded as formed on the type of a molecule of hydrogen, $\begin{matrix} H \\ H \end{matrix}$, and some have used the hydrochloric acid type, $\begin{matrix} H \\ Cl \end{matrix}$, but it is clear that the hydrogen type includes this latter, as hydrochloric acid, as we have seen in a former article, is produced by the displacement of an atom of hydrogen in the molecule by an atom of chlorine. All bodies which can be formed by substitution for hydrogen of elements or compounds, may be referred to this type, as, for example, in hydride of ethyl, $\begin{matrix} C_2\ H_5 \\ H \end{matrix}$, one atom of hydrogen of the type is replaced by $C_2\ H_5$, and the second atom can be replaced by an atom of a metal, as in zinc ethyl, which is formed on the type of two molecules of hydrogen, zinc being divalent, its formula, therefore, is $\begin{matrix} (C_2\ H_5)_2 \\ Zn \end{matrix}$. When this zinc ethyl is brought to react on water it is immediately decomposed, hydride of ethyl and zinc hydrate being formed thus—

$$\begin{matrix} (C_2\ H_5)_2 \\ Zn \end{matrix} + 2\ \begin{matrix} H \\ H \end{matrix} O = \left(\begin{matrix} C_2\ H_5 \\ H \end{matrix} \right) 2 + \begin{matrix} Zn \\ H_2 \end{matrix} O_2.$$

The second typical hydrogen in hydride of ethyl can be removed,

* "Journal of Chem. Soc.," vol. iv., p. 229.

and another atom of ethyl can be substituted for it, and the resulting body is ethylate of ethyl. The well-known gas, marsh gas, $C H_4$, is the hydride of methyl, $\begin{matrix} C H^3 \\ H \end{matrix}$, and is, therefore, referable to this type; its preparation from sodic acetate and sodic hydrate confirms this, for, although the action is in one sense analytical, it is, as regards the formation of marsh gas, truly synthetical—

$$Na\,(C_2\,H_3\,O_2) + Na\,HO = \underset{\text{(Marsh gas).}}{C\,H_3\,H} + Na_2\,CO_3,$$

for methyl, $C H_3$, is afforded by the sodic acetate, and hydrogen by the sodic hydrate.

When the elements of a molecule of water are expelled by heat from a molecule of acetate of ammonium, a body remains, the composition of which may be explained by writing it on the type of a molecule of ammonia.

$$\left.\begin{matrix} C_2\,H_3\,O \\ NH_4 \end{matrix}\right\} O - H_2\,O = \left.\begin{matrix} C_2\,H_3\,O \\ H \\ H \end{matrix}\right\} N.$$

This body is termed acetamide, and is one of a large class of ammonias in which acid radicals are substituted for the atoms of hydrogen in ammonia. These amides, as well as the amines (whose constitution differs from them in this respect, that, whereas the amides contain hydrogen, the amines do not), may all be represented on the ammonia type. The well-known compound, urea, which is an amide of carbonic oxide, will serve as a good illustration, and it is ammonia in which two atoms of hydrogen have been replaced by CO, the substitution is easily understood, when ammonia is made to act on ethylic carbonate. It may be well, in order to simplify the matter, to show first the formation of ethylic carbonate. Carbonic acid, plus the elements of a molecule of water, may be represented thus: $\left.\begin{matrix} CO \\ H_2 \end{matrix}\right\} O_2$ on the type of two molecules of water, and if two atoms of ethyl be substituted for the two atoms of typical hydrogen, we shall get $\begin{matrix} CO \\ (C_2\,H_5)_2 \end{matrix} O_2$ ethylic carbonate, and when this is acted upon by ammonia, we shall get the following decomposition—

$$\underset{\text{(Ethylic Carbonate.)}}{\begin{matrix} CO \\ (C_2\,H_5)_2 \end{matrix} O_2} + \underset{\text{(Ammonia.)}}{\begin{matrix} H_2 \\ H_2 \\ H_2 \end{matrix} N} = \underset{\text{(Urea.)}}{\begin{matrix} CO \\ H_2 \\ H_2 \end{matrix} N_2} + \underset{\text{(Vinic Alcohol.)}}{\begin{matrix} (C_2H_5)_2 \\ H_2 \end{matrix} O_2};$$

it is here clearly seen that CO is directly made to take the place of

two atoms of hydrogen in two molecules of ammonia. Another reaction, by which urea is produced, also confirms this synthesis; cyanate of potassium, with sulphate of ammonium, gives the following double decomposition—

$$\begin{matrix} K \\ CN \end{matrix} O + \begin{matrix} NH_4 \\ H \end{matrix} SO_4 = \begin{matrix} K \\ H \end{matrix} SO_4 + \begin{matrix} CO \\ H_2N_2. \\ H_2 \end{matrix}$$

(Potassic Cyanate.)

The ammonia type is also used to represent the constitution of those compounds which other trivalent elements form with hydrogen; and in which it may be considered that the nitrogen in ammonia is replaced by phosphorous, arsenic, or antimony.

Phosphoretted hydrogen PH_3 is evidently an ammonia in which the nitrogen is replaced by phosphorus, and may be written on that type, as also may be arsenuretted and antimonuretted hydrogen.

$$N \begin{matrix} H \\ H \\ H \end{matrix} \qquad P \begin{matrix} H \\ H \\ H \end{matrix}$$

(Ammonia.) (Phosphoretted Hydrogen.)

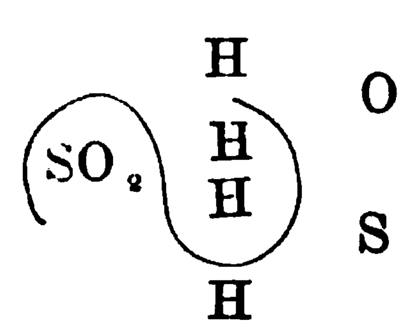
$$As \begin{matrix} H \\ H \\ H \end{matrix} \qquad Sl \begin{matrix} H \\ H \\ H \end{matrix}$$

(Arsenuretted Hydrogen.) (Antimonuretted Hydrogen.)

We have hitherto only considered those cases in which the hydrogen of the type is replaced by elements or radicals. The chlorous element can also be changed, and this is well illustrated in the case of sulphuretted hydrogen, which, from its formation, may be regarded as a molecule of water in which the atom of oxygen is replaced by an atom of sulphur; for if hydrogen be evolved from water in the presence of hydro-sulphurous acid, sulphuretted hydrogen is given off; and this can be effected by mixing hyposulphite of soda with water and sodium amalgam, the hydrogen evolved from the water by the action of the sodium decomposes the hyposulphite, sulphur being set free, which at the moment of its liberation unites with hydrogen, taking the place of the oxygen of the water which has been abstracted by the sodium to form sodic oxide Na_2O. In addition to the simple types, which have been briefly noticed, others are employed, without which it would be possible to represent only a very limited number of reactions; for example, phosphoric acid (tribasic H_3 PO_4) may be represented on the type of three molecules of water $\left.\begin{matrix} PO \\ H_3 \end{matrix}\right\} O_3$, or on that of two

molecules of water $\left.\begin{matrix}PO_2\\H_3\end{matrix}\right\}O_2$, in which the first radical PO can replace three atoms of hydrogen, but the second PO_2 is able to replace but one. Meta-phosphoric acid may be represented on the type of one or two molecules of water thus: $\left.\begin{matrix}PO_2\\H\end{matrix}\right\}O$, or $\left.\begin{matrix}PO\\H\end{matrix}\right\}O_2$. It is, however, beyond our present purpose to go more fully into this very interesting subject. For further information on the "Constitution of Acids and Salts," the reader is referred to a remarkably clear and able paper, by Professor Odling, in the journal of the Chemical Society.*

Before dismissing this subject, however, there is another kind of type which should be noticed, as it makes clear the constitution of such bodies as the hypo-sulphites; it is a compound type, and its application is peculiarly useful where the types we have been considering do not appear to be sufficiently comprehensive. Hypo-sulphite of soda, a salt of considerable importance, is made by passing sulphurous acid SO_2 into a solution of sodic sulphide, and the formula of the salt is $Na_2S_2O_3$. Rose says that there is also a molecule of water (constituent water) in this salt, and that the formula for it is $Na_2H_2S_2O_4$. Whether this be the case or not, it does not seem to make any difference in the formation of the salt, which is effected by the replacement of two atoms of hydrogen in one molecule of water, and one of sulphuretted hydrogen by sulphurous acid SO_2, thus—



so that one atom of hydrogen is taken from the water, and another from the sulphuretted hydrogen, their place being supplied by the radical SO_2, which binds them together into a new compound—hypo-sulphurous acid.

I had intended entering somewhat fully into the consideration of what is termed the saturation of molecules; the subject has been already alluded to several times; it is, however, one whose range is so wide, that it seems better to leave it for a separate treatment, which it well deserves, at some future time. The attention of chemists has been of late much directed to it, and various methods

* "Chem. Soc. Journ.," vol. vii., page 1.

have been recommended for rendering clear and intelligible what is, to say the least of it, a very difficult subject. Graphic formulas have been devised and material representations of atoms used, which, however much they may assist in explanation, tend to give incorrect views, as representing what we have had, as yet, no opportunity of knowing, viz., the form and arrangement of atoms in a molecule. It is sufficient for the present to state that, with few exceptions, the free molecule has all the valent powers of its constituent atoms satisfied; by this is meant that, in such a body as marsh gas, CH_4, carbon, which is tetravalent, is completely satisfied by the four atoms of hydrogen which enter into its composition; and that, in olefiant gas, C_2H_4, the carbon is only half satisfied by four atoms of hydrogen, for the carbon is double what it is in marsh gas, and the remaining carbon of one atom satisfies the remaining carbon of the other; that is, the carbon which is not satisfied by hydrogen; and the molecule is stable, its atoms being all held firmly together by the powerful attraction which the carbon has for itself. A good illustration of the force with which the atoms of an element unite with one another is afforded by the decomposition of iodide of nitrogen. Here we have an unstable body which is decomposed even by the friction of a feather on its surface, and the decomposition is attended by the evolution of light and intense heat, a violent explosion accompanying the action. But decomposition is always attended by the absorption of heat, how then is this apparently strange manifestation to be accounted for? The atoms of iodine and nitrogen, when set free from their forced union, unite together to form molecules of the free elements, and as has been shown before, in the case of iodide and iodate of potassium, a very slight disturbing force destroys an equilibrium which is, at the best, but unstable; and the heat and light evolved in the decomposition of iodide of nitrogen are consequent on the union of some atoms of nitrogen with others, to form free nitrogen, and those of iodine with iodine to form the free element. Again, in water, oxygen holds together two atoms of hydrogen by its divalent property. In acetate of potash, $\frac{C_2H_3O}{K}O$, where one atom of hydrogen in the molecule of water has been replaced by othyl and the other by potassium, oxygen exerts the force which holds the atoms of the molecule of that salt together; and the power of oxygen is great, for, when two atoms of chlorine are substituted for oxygen, by the action of pentachloride of phosphorus, they have not the power to preserve the molecule entire; it breaks up into two separate com-

pounds, hydrochloric acid, HCl, and chloride of othyl, $C_2H_3O.\atop Cl$ From these examples it will be seen, that in compounds there is an element which acts as a coupler, so to speak, which collects around it and holds firmly together other bodies, elements, or compounds, with which it is for the time associated, and it continues to hold them, until it is itself overpowered by the action of some reagent whose influence it cannot resist, and that the stability of a compound depends upon the force which this element or radical is able to exert. From the brief and imperfect explanation of some of the new theories in chemistry, which has been given in these articles, it is to be hoped that the reader, who was before unacquainted with them, will be led to see that, however imperfect our present knowledge and theories may be, still vast strides have been made, based on a sound and rational foundation, in a direction which is continually leading to the discovery of fresh facts, confirmatory of those views which we have been considering, and for a knowledge of which the writer is mainly indebted to the teachings of Professor Williamson.

VEGETABLE FIBRES AND THEIR MICROSCOPIC CHARACTERS.

BY M. VETILLARD.*

LINEN, FLAX.—When we examine with the naked eye a filament of the finest and best flax, we are tempted to suppose it simple and homogeneous. On submitting it to the microscope we find that it is a bundle of slender fibres in juxtaposition and adhering one to another. If we destroy this adhesion by the successive and moderate application of boiling alkalies and alkaline chlorides, and by the mechanical action of a couple of needles under the simple microscope, we at last obtain separate fibres, varying in length from several millimetres to 0·06m, and less. If we place these fibres in an asphalt cell with glycerine or, still better, with one of the liquids employed by M. Bourgogne, and magnify them two hundred or three hundred times, the following characters appear.

The isolated fibres, or cells composing the flax filaments are seen as transparent tubes, the internal cavity of which is very small as compared with the external diameter. Frequently this cavity is not

* Translated from "Comptes Rendus." No. 19. 1868.

visible. The surface of the filament is sometimes smooth, sometimes finely striated in the direction of its length. Its diameter is usually pretty uniform, except at the extremities. It is sometimes flattened, but in that case is not twisted upon itself like cotton. The extremities terminate in points, fine, and elongated like needles. This character will be recognized in a collection of the cells, but there are exceptions, though this is the predominant form. Flax filaments seen in very thin transverse section exhibit agglomerations of polygons, with angles always salient, and straight sided, or slightly convex, where the filaments run from the body of the fibre. In the centre of each polygon is a black, or brilliant spot, according as the instrument is arranged, and this indicates the interior canal of the fibre. This canal is usually very small, rounded, and seldom flattened. The filament appears solid and almost full. Sometimes we perceive, though feebly, the layers of cellulose of which it is formed.

Hemp.—Hemp when divided under the simple microscope, exhibits cells similar in length to those of flax, but, on the average, rather stouter. The longitudinal striæ are deeper and more decided. They frequently exhibit very apparent salient sides. Hemp is more frequently flattened than linen, and its diameter is more variable. We never met with spiral striæ, whatever treatment we employed, or whatever might be the age of the plant. When hemp has been strongly bleached, deep well-marked fissures are seen in most fibres; they are always parallel to their axes, and we never met with them oblique, as in linen.

The points of the cells are generally flattened, the ends rounded, and of very various shapes. Some are like spatulæ, others like lances, but most commonly the points are very irregular. Sometimes we find the ends forked, but this peculiarity belongs chiefly to the foot cells (*cellules du pied*).

Sections exhibit very irregular and varied shapes. Sometimes polygons with salient angles, at others, and most frequently, they show irregular figures with retreating angles and rounded contours. In masses these figures are seen interlaced. They are in such close contact that it is often impossible to distinguish lines of separation, and the whole appears as a homogeneous mass. The lines of separation can only be recognized by management of the illumination.

In the interior of the sections we notice an aperture representing the central canal. This opening is usually elongated, and conforms to the external form, being usually as irregular.

Jute.—Jute comes to us from Asia, and is extracted from the bark of a *Corchorus*. When jute filaments are carefully treated

with alkalies and alkaline chlorides to destroy the incrusting matter, it exhibits under the lens an agglomeration of thick stout fibres, regular in diameter, and strongly marked with striæ parallel to their axes. The filaments, which at first sight seem simple, can be divided by the needle, and resolved into short stiff cells, terminating in points. Their length varies from 0·0015m to 0·003m, and sometimes they reach 0·005m. The body of these fibres, seen under magnification of from two hundred to three hundred linear, appears flat, and bordered with bright lines, which represent the thickness of the cell walls, which is generally slight when compared with the dimension of the fibres. The surface is smooth, and shows no trace of fibrous structure, like that of hemp or flax. The margins of the fibres are not always united, but frequently toothed, and showing deep and salient sinuosities. This character is noticed at the points, which are sometimes acute, but more often rounded, or with irregular terminations. The central canal is visible to the extremity of the point.

Sections exhibit agglomerations of polygons with straight sides, closely approximated in groups. In the midst of each polygon a round smooth aperture may be seen, usually very large in proportion to the exterior diameter.

Phormium tenax.—This fibre is obtained from the vascular bundles of the plant so named, and well known in France for its ornamental character. Seen under the simple microscope, after slight bleaching, it first strikes us on account of the fineness and regularity of its filaments, which separate with great facility. Their length varies from 0·005m to 0·011m. With the compound microscope we see that the diameter of these fibres is of remarkable uniformity all through their length. The central canal is generally very large, and made visible by bright lines at the margins, indicating the thickness of the walls. The points always end alike. They gradually diminish and become circular.

Sections of the raw fibre are most closely allied to those of hemp. They form groups which might be confounded with those of the latter; and the central cavity, large and rounded, has the same appearance. The polygons do not, however, appear in such close contact, and their angles are often rounded. When sections are made from a strongly-bleached specimen, the branches are almost always isolated; and in the group the component pieces are slightly separated. In jute, on the contrary, when submitted to the same treatment, the groups remain entire, and it is rare to see an isolated section.

China Grass comes to us from China, in tissues known as China Grass Cloth, and made of the fibres of a nettle, *Urtica nivea*, or *Bœhmeria nivea.* This fibre, carefully bleached, divides easily with needles, the filaments separating without effort. This character differentiates it from hemp, the produce of another plant of the nettle family, and which it somewhat resembles in form, but the fibres of which, when thoroughly bleached, preserve a considerable adhesion to each other. The former are also much larger than the latter; their mean length being double. We have found the length of china grass fibre vary from 0·05m. to 0·12m., whilst those of hemp rarely reach 0·06m.

China grass is, like hemp, often marked with furrows and salient sides. The surface is sometimes uniform, but more frequently garnished with very striking longitudinal canals and fine striæ. In parts near the edges fibrils may be noticed, which seem to detach themselves from the body of the cell. They proceed from the sides or furrows which have been torn, and portions of which still adhere to the surface. We observe, also, a character which this fibre possesses in common with that of flax, in the fissures oblique to the axis, and indicating a spiral disposition in the fibrils. We can also see, in certain very flattened portions, internal striæ, which seem to cross each other. This arrangement is like that in flax. The points are in general lanceolate and less irregular than those of hemp. They begin to thin out at a considerable distance from the termination, and, compared with the body of the filaments to which they belong, they are finer and more elongated than those of hemp.

Sections offer many resemblances to those of hemp. They exhibit themselves in groups when the fibre is raw; their shape is very irregular, with rounded margins; but the filaments are less matted together, and their contact less close. Generally flat and broad, they have some analogy with those of cotton when they are isolated.

Cotton is a hollow fibre, gradually tapering towards the point, which is usually blunt and rounded. It forms a kind of sack, open at one end and shut at the other, and with walls pressed together. Under the microscope the fibres or hairs appear completely isolated. They are flat and twisted. This arrangement, which has been long known, is characteristic of cotton. At the edges of the filaments we see bright lines separated by light shades, which give the appearance of a marginal cushion (*bourrelet*). They mark the thickness of the wall, which is usually very small in comparison with the internal cavity. We have not discovered any trace of

fibrous structure in cotton. Its substance appears membranaceous. It is often folded in an irregular manner, as might happen to a thin membrane exposed to pressure. The points are usually rounded.

Sections of cotton are perfectly characterized by their rounded outlines, and their elongated forms commonly folded over each other towards the extremities. They often resemble sections of a kidney (*rognon*). The central canal is represented by a black line, which follows the contour of the section. The sections are never in groups, but always isolated.

Cotton is easily distinguished from other fibres employed in industry by the shape of its sections, and by the twisted appearance of the fibres seen lengthwise. These two characters enable it to be recognized in all mixtures.

THE ROYAL SOCIETY'S CATALOGUE.*

At the Glasgow meeting of the British Association in 1855, Dr. Henry, secretary to the Smithsonian Institution, suggested the formation of a General Index to the contents of the Transactions, Journals, Comptes Rendus, or by whatever name they might be called, published by the learned societies of Europe and America; but nothing was done towards carrying out his views, except a little talking, until 1858, when the Royal Society, with a spirit worthy their position in the world of science, took the matter up, and, extending their views, made serious preparations for compiling an Index, not only of the Transactions, but also of the scientific periodicals, that had been published between 1800 and 1863. It was a great scheme, and in its comprehensiveness without a parallel. Agassiz, Carus, Engelmann, Hagen, and Poggendorff had published indexes more or less limited in their scope, and despite their imperfections and errors, very useful to the student; but it is only necessary to compare the list of papers assigned to any individual in any of their works with that compiled by the Royal Society to recognise the great superiority of the latter.

The first volume alone of the Royal Society's Catalogue is completed, forming a handsome quarto of over one thousand pages, printed in double columns, and extending from A to CLU. We give a specimen to show the plan upon which it has been prepared, although

* "Catalogue of Scientific Papers (1800—1863), compiled and published by the Royal Society of London." Vol. i. London. 4to.

the longest extract for which we could find space would be but taking a brick to show the quality of a house.

Chateauneuf, *B. de.* Ueber die Fruchtbarkeit in Europa im Anfang des 19ten Jahrhunderts. Froriep, Notizen, XVI., 1827, col. 177-180.

Chatin, *Adolphe,* et **Sandras.** Sur un sang blanc. Journ. Chimie Méd. V., 1849, pp. 305-311; Erdm. Journ. Prak. Chem. XLVII., 1849, pp. 427-431.

Chatterley, *W. M. F.* Report of some experiments with Saline Manures containing Nitrogen. Chem. Soc. Mem. I., 1841-43, pp. 152-158; Phil. Mag. XXII., 1843, pp. 470-477.

Chevreul, *Michel Eugène.* **41.** Recherches sur plusieurs points de Chimie Organique, et considérations sur la nature du sang. Paris, Mus. Hist. Nat. Mém. X., 1823, pp. 443-451; Magendie, Journ. de Phys. IV., 1824, pp. 119-127; Schweigger, Journ. XLIII. (= *Jahrb.* XIII.), 1825, pp. 242-246.

Chiaje, *Stefano delle.* **21.** Ricerche intorno all' esistenza del Polistoma del sangue umano. Il Progresso, XI., 1835, pp. 76-90; Froriep, Notizen, IV., 1838, col. 245-246.

A list of abbreviations explains the contracted references, and gives the titles in full of nearly 1400 works that have been indexed, making in all certainly not less than 20,000 volumes. These are in all languages and from all countries—Chili and Canada, Tasmania and the Cape, Finland and Sicily, China and California furnish their contingent; and if the harvest from some quarters is but scanty, we must bear in mind the difficulties that have been overcome to procure even that. We could have wished, indeed, that there had been fewer deficiencies, especially in cases where the defects might have been supplied at a very small cost of money and trouble. If the third volume of the "Annales des Mines" was not in the library of the Royal Society, or could not be found in England, surely there are libraries in France where it could be seen and indexed. Similarly we have to regret the absence of vol. ii. of the "Memoirs of the Linnæan Society of Paris." Of other series it would appear that only a single volume has been indexed, as vol. viii. of the "Gratz Jahresbericht," and of the "Recueil" issued by the Agricultural Society of Agen. Surely in these three cases (and there are many more) a letter to the respective secretaries or librarians, stating the object of the application, would have received a prompt and satisfactory reply. We point to these shortcomings in the hope that they may be amended in future volumes, as we gather from a supplementary list on page lxxix., that many deficiencies have been filled up while the first volume was going through

the press. The Royal Society deserves great credit for thus determining to make each volume as perfect as they can, incorporating their new materials as they go on, and not reserving them for an appendix volume.

We are not quite satisfied that the rules for the arrangement of authors' names are the best that might have been devised. It is all very well to speak of "following the practice of the respective countries," but it has not been done. One great exception is made of Spanish authors, whom Spaniards would classify under their Christian names, while the Royal Society—very properly, we allow—arranges them under their family names. According to the French rule for compound names, *Dupetit Thouars* is catalogued as *Aubert Dupetit Thouars*. This may be pedantically correct, but it is practically wrong. The papers should have been reserved either for *Dupetit* or *Thouars*, with only a cross reference from *Aubert*. Very properly *Ducrotay de Blainville* has been indexed under *B*, but it is against the Society's rule. We demur also to the rule by which "the prefixes *D'*, *Da*, *Dal*, *De*, *Del*, *Della*, etc., are not considered part of the name." Why should *Du* and *Des*, according to Rule II., be considered part of the name, when *Del* and *Della* are rejected? If we treat *Della Marmora* by Rule I. we must look for it under *M*; if by Rule III., under *L*. The wiser plan would have been to have discarded all the pedantic rules of bibliographers, and, cutting off all prefixes, to have regarded the name without any preposition or article. A good opportunity of bibliographical reform has been thrown away. We are to wait for Candolle's papers until the second volume appears, because, in defiance of Rule I., he has been indexed as *De Candolle*.

If the scientific student desires to have a list of the memoirs of any particular man, to know when they were written and in what books they were published, he has only to consult the Index. He will find the titles of 160 memoirs by Arago, 121 by Aub. Becquerel, 127 by Louis Agassiz, 136 by Chasles, 258 by Berzelius, 302 by Biot, 308 by Cayley, and 478 by Cauchy, who heads the poll in this volume. On a fair estimate the volume contains the titles of 30,000 separate papers, but, as many of them have more than one reference, they must represent at least 50,000, and yet they only carry us half way through the letter C. Calculations like this show the immense amount of labour that has been gone through, and serve to increase the wonder we feel as we turn over the leaves of this truly gigantic work. Doubtless it contains errors, for no book is exempt from them; but, so far as we have been able to test the

volume before us, we have had reason to be surprised at its accuracy. This makes us the more regret that a sort of red-tapey feeling has prevented the Royal Society from giving credit to the persons whose labours have contributed to this happy result. If it was thought right to make honourable mention of two foreign gentlemen who contributed a few score of titles that might not otherwise have been procured, surely it was not less advisable to let the scientific world know how great a debt they owe to the unflagging watchfulness and zeal of Mr. Busk, Secretary to the Linnean Society, and Dr. Sharpey, Secretary to the Royal. Honour to whom honour is due; and, while honouring them, we must not forget the working editor.* It is too often supposed that a money payment cancels all obligations in such matters; but there are many things done by an editor which make no show, and yet no money can repay them. The Royal Society were fortunate in their selection of a man who possessed both the theoretical and technical knowledge which such a work demands. It is not fair to ignore his services. As he will have to bear reproach for any imperfections and errors that may be found in this important work, it is but just that he should have the credit for what he has done, and done so well.

FACTS ABOUT LINNE.

BY W. R. BIRT, F.R.A.S.,

Secretary, British Association Moon Committee.

THE volume of "Reports of the British Association for the Advancement of Science, 1867," has just been issued. In an appendix to the Report of the Lunar Committee, numerous observations of Linné, from 1788, Nov. 5, to 1867, Dec. 4, are collected. They have reference to the white spot, the shallow crater, and the small crater. Of the shallow crater, eleven observations only are recorded, and these are, to a certain extent, *discordant*. There is, in the whole of the observations given, one very important omission, viz., a description of the objects near Linné. This probably arises,

* Dr. White has earned a reputation in literature by other works besides the "History of the Massacre of St. Bartholomew," which we reviewed in our March number.

in some cases, from the smallness of the apertures employed, in others, from the non-visibility of surrounding objects as the sun attains greater altitudes above the horizon of Linné, and in a few from an absence of sufficient attention to them while observing Linné. On June 26, 1868, 9.45 G.M.T., I had a very favourable view of Linné with the Crossley equatorial of 7·3 inch aperture, powers 122, 182, and 384. Sun's altitude at Linné, 0° 46·5′; azimuth, 87° 53·6′ from the S. point. Nothing was visible but a small cone casting a shadow to the east, not quite so distinct and persistent as the shadow of the highest part of the ridge to the south (the sixth ridge of Schröter, "Report, British Association, 1867," p. 4). This cone is not situated upon the ridge, as Schröter states his spot *v* to be, but is isolated, and stands upon a slightly raised portion of the surface of the Mare Serenitatis, having Schröter's sixth ridge to the south (the cone is in the line of prolongation of this ridge to the north). On the west is a curvilinear ridge of lower altitude (given by Beer and Mädler), from the east foot of which the surface very slightly rises to the base of the cone of Linné. On the 26th of June there was not the slightest indication of a shallow crater, nor was there the least appearance in the surface around the cone which might be considered indicative of its becoming a white spot as the sun rose above it. The terminator was a little east of the cone, and the next ridge beyond the cone towards the east was becoming visible. Mr. Huggins, Mr. Carpenter, and Mr. Penrose observed Linné the same evening, and delineated the features above-named. Mr. Carpenter also gives the crater opening *on* the cone. The Rev. T. W. Webb also observed the same features, and particularly remarked the absence of a short branch of the main ridge from Sulpicius Gallus, pointing to Linné, which is given by B. and M. The portion of the Mare Serenitatis on which the cone was seen, is so surrounded by ridges as to be easily taken for a large shallow crater, and it may be that some of the discordances previously alluded to may be thus explained. There are, however, a few outstanding points, as Mr. Knott's "Ghost" of the ring of Linné, less in diameter than Sulpicius Gallus, and Mr. Webb's ring; about as large as Linné, as figured by Beer and Mädler. Neither of these would extend over the space around the cone included by the ridges before alluded to.

Mr. Webb has been very successful in observing Linné under low solar altitudes. 1867, August 6 (morning illumination) he saw in the place of Linné a small white crater, or hill *on the terminator;* and on Feb. 24 and Nov. 17 (evening illumination) he saw the same appearance; in November *also on the terminator.* The observations

of June 26, 1868, are confirmatory of Mr. Webb having observed the west and east slopes of the cone of Linné, and that this was the actual state of Linné in 1867 and 1868.

There are one or two interesting features in the observations of June 26. We appear to have obtained an *unexceptionable* view of Linné and its surroundings. Its real aspect, that of a small truncated cone, with crater opening unaffected by circumstances which, at a later period of illumination, tend to *obscure*, and even obliterate, both cone and crater, was clearly apprehended by *each* observer. The nature of the surface of the Mare Serenitatis on which Linné is situated, was also plainly apparent, so far as *level* is concerned. This surface departs in a very trifling degree from a plain, and is nearly surrounded on all sides by ridges, so that Linné is nearly central with regard to them. The complete negation of the shallow crater is an important result, inasmuch as we have now to deal with the cone and the white spot. As before observed, the apparent state of the surface on June 26 did not indicate a probable future appearance of the white spot as the sun rose higher. We are, however, greatly ignorant of the *true* nature of the moon's surface. The extent of our knowledge appears to be of a twofold character. *First*, we perceive *differences* of colour and brightness, from which we infer that the surface consists of different materials reflecting different degrees of light, and also of tint. *Second*, the presence of *shadow* reveals to us manifest irregularities of surface as regards level, elevation, and depression. Of the nature of the surface beyond these two characteristics we are unacquainted, and can only trace out slowly certain analogies with phenomena that are familiar to us in the earth's crust.

The inequalities of surface near Linné have been clearly brought out by the shadows cast under so low an altitude as 0° 46·5′. Some approximation to a knowledge of the nature of the white spot may be obtained when we are successful enough to observe it at its first appearance. On July 8, 1867, sun's altitude 4° 45·5′, azimuth 86° 2·8′ from the south point, the indistinctness of the white spot, as contrasted with the sharpness of definition of objects in the neighbourhood, was very apparent (See "Report, British Association, 1867," p. 8) with an aperture of 4¼ inches. At the same time, with an aperture of 8 inches, Mr. Huggins saw and sketched the cone and western ridge, which then appeared as the western wall of a *shallow crater*. Herr Schmidt also observed the cone on the same evening (See "Report, British Association, 1867," p. 19), but he says nothing about the white spot. The increase of brightness of

the white spot as the sun attains a greater elevation above it, appears from observations made in December, 1866, and January, July, and August, 1867 (See "Report, British Association, 1867," p. 10). The desiderata connected with this appearance of Linné, are the altitude and azimuth of the sun under which it is first seen, and the determination of the character of the surface around the cone, especially if it is such as to give rise to a white spot when the rays of the sun strike it more directly.

SUPPOSED CHANGES IN THE MOON.—LETTER FROM SCHIMDT.

(*With a Plate.*)

The following important letter from the Director of the Athens Observatory has just been received by Mr. Birt, the Secretary of the British Association Lunar Committee. The original communication is in German; but Mr. Birt has kindly transmitted to us a translation made by our esteemed contributor, Mr. W. T. Lynn, of Greenwich Observatory. The accompanying engraving is copied from sketches made by Herr Schmidt, and sent to Mr. Birt, to whom we are indebted for the use of them.

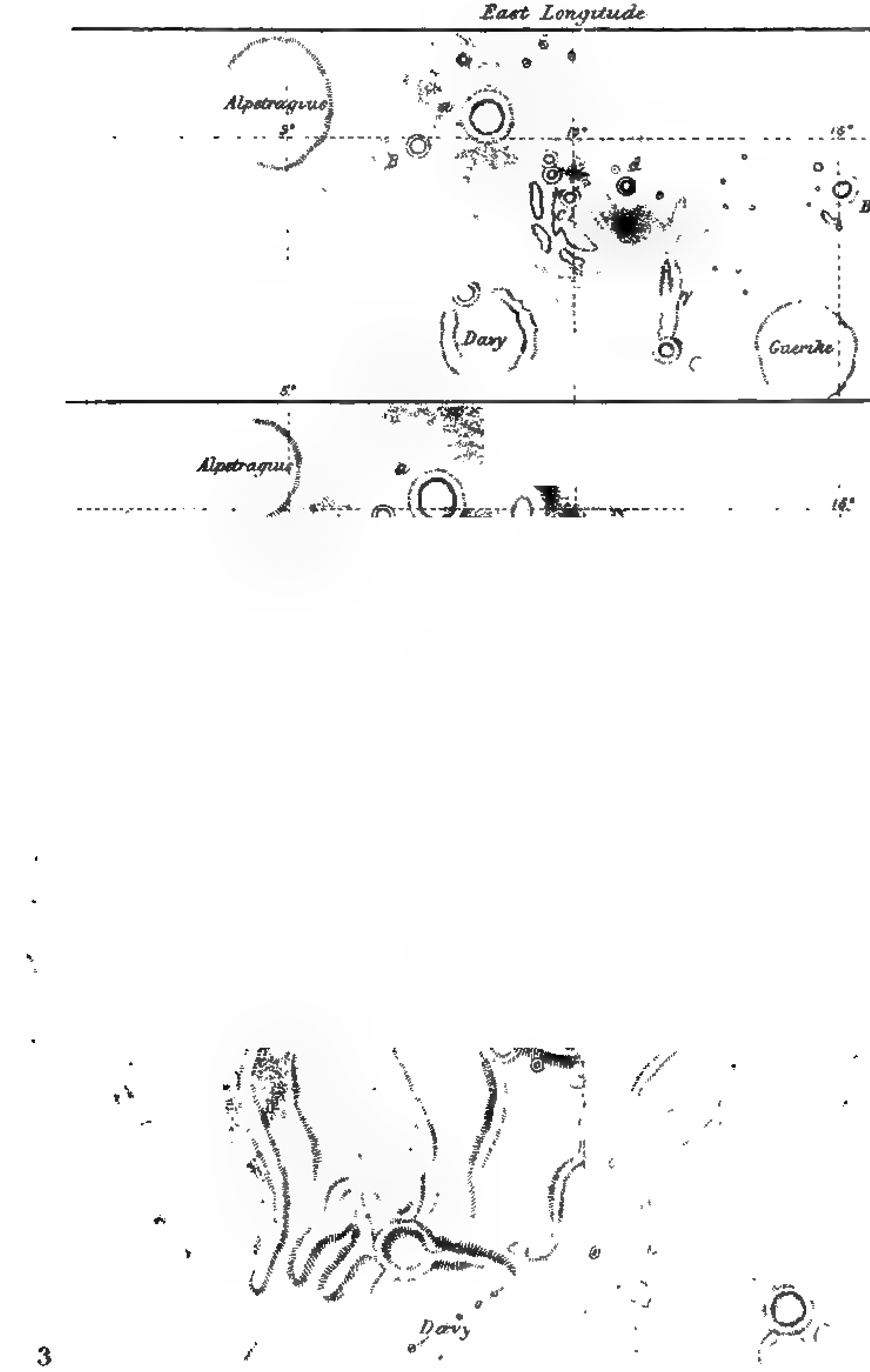
From Herr J. F. Julius Schmidt to W. R. Birt—

"Athens, 1868, June 5.

"Honoured Sir,

"I have lately given attention to a region of the Moon which deserves in future a more accurate investigation. Although it furnishes by no means so significant a case as was afforded by *Linné*, it shows, however, something analogous, and leads to a better knowledge of certain spots of light which cannot, in all cases, be explained by mere phenomena of reflection. The region in question is situated easterly, near Alpetragius, the spot of light to which I direct your attention in 12° east longitude and 14° south latitude = d. Schröter has nothing about it. Lohrmann's (unedited) plate gives a very large spot of light, almost 2° in magnitude, and a very small hill inside it.

"Mädler draws a crater of almost a mile diameter, and says, in his 'Selenography,' (Der Mond), p. 304, line 22 from above—



1. MÄDLER, 2 LOHRMANN, 3. SCHMIDT

"'In the farthest east shines also, with a light of 8°, the small crater d.'

"This crater d now no longer exists; but, in its place, a round spot of light, more than two miles broad, extremely brilliant, which has quite the character of the light spot *Linné*, and of the few others of this kind, which are also found upon the Moon. The small neighbouring crater south of d, which Mädler gives, is still distinctly visible.

"I have annexed three sketches, the first from Mädler, the second from Lohrmann, the third my own on the scale of my chart.

"Will you have the goodness to take an opportunity of informing the Lunar Committee of this notice, and request new observations with large instruments.

"With the greatest esteem, yours most truly,

"J. F. JULIUS SCHMIDT."

SYNONYMS.—B. and M. Alpetragius d Brit. Assoc. III A^{v4}.
Craterlet „ „ III A^{v5}.

Letter from W. R. Birt, Esq., to the Editor.

"BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
"LUNAR COMMITTEE.
"Secretary's Office, Cynthia Villa, Walthamstow, London, N.E.
"June 30, 1868.

"MY DEAR SIR,

"Last evening I had an excellent opportunity of confirming Schmidt's drawing of Alpetragius d, and found it a faithful representation of the spot as it now is, with, perhaps, the exception of the white spot on the Moon, being better defined, and in more striking contrast with the surface near it. Two friends were with me, who also bear testimony to the accuracy of Schmidt's drawing. Of course I failed to identify the features as depicted by Lohrmann and Mädler. The little crater was plainly visible on the south edge, as given by Schmidt.

"On Friday evening, June 26, I observed *Linné*, with a solar altitude of about three-quarters of a degree, or 0° 46·5′, and found that it presented the appearance of a small cone upon the surface of the Mare Serenitatis, E. of a somewhat sinuous ridge, and N. of the more conspicuous ridge between *Linné* and *Sulpicius Gallus*. Between the cone and the W. ridge, and also on the

surface, E. of the cone, I did not observe the slightest appearance indicating the previous existence of a *crater*, either large or small; no remains of a broken ring, nor anything apparently in the nature of the *surface* around the cone from which, under a greater solar altitude, it might be inferred that the reflection would be stronger, and give rise to a white spot. Of the shallow crater not a trace was discernible, the base of the cone being situated on the nearly level surface of the Mare, but rather elevated than depressed. Indeed, I saw nothing but the bare cone, which was, as well as all the small objects in its neighbourhood, clearly defined.

"These observations were made with the Crossley equatorial of 7·3-inch aperture, powers 122 and 182.

"This is the first occasion on which I have seen anything different from the white spot, and, as you will readily judge, it seems to increase the mysteriousness of the object.

"I am, my dear Sir, yours very truly,

"W. R. Birt."

ASTRONOMICAL NOTES FOR AUGUST.

BY W. T. LYNN, B.A., F.R.A.S.

Of the Royal Observatory, Greenwich.

Both the inferior planets will be morning stars this month, and will therefore not be visible in the evening. Mercury will be in superior conjunction with the Sun on the 28th day, and will therefore about that time not be visible at all. Venus will be a magnificent object before sunrise, in the constellation Gemini. She is at her greatest brilliancy as a morning star on the 21st, and is horned, the crescent constantly increasing, whilst the apparent diameter is diminishing. At the beginning of the month, she rises about three o'clock in the morning; at the end of it, about half-past one.

Mars rises at the beginning of the month half an hour after, and at the end of it about a quarter before, midnight. He will consequently be very low in the heavens, when visible at all, throughout the month.

Jupiter rises on the first day at 9h. 45m., on the last day at

7h. 44m. He is, during the whole month, within two or three degrees of the fourth magnitude star, ϵ Piscium, and is in conjunction with the Moon on the afternoon of the 8th. The following phenomena of his satellites have been selected for evening observation, the same remarks as to the amount of accuracy of the times being applicable that were made in the last number of the STUDENT. The shadow of the planet being directed to the left hand, as seen in an inverting telescope, the eclipses of the satellites will all take place on that side. The first and second will disappear at a small distance only from Jupiter; but since, when they emerge from his shadow, they will be to us behind the planet, no reappearance from eclipse will be seen, but the reappearance will be from occultation. The disappearances of the third satellite in the shadow will take place distant by nearly a diameter of the planet from him: the reappearances very near his disc. Neither transit, occultation, nor eclipse of the fourth satellite will occur.

DATE.	SATELLITE.	PHENOMENON.	MEAN TIME.
			h. m.
August 7......	II.........	Occultation, reappearance......	11 35
„ 8......	I.........	Eclipse, disappearance	12 25
„ 9......	I.........	Transit, ingress	10 54
„ 10......	I.........	Occultation, reappearance......	10 14
„ 10......	III.........	Occultation, reappearance......	10 18
„ 16......	I.........	Transit, ingress	12 41
„ 17......	III.........	Eclipse, reappearance	9 46
„ 17......	III.........	Occultation, disappearance ...	11 18
„ 17......	I.........	Occultation, reappearance......	12 2
„ 21......	II.........	Eclipse, disappearance	11 56
„ 23......	II.........	Transit, egress	10 28
„ 24......	I.........	Eclipse, disappearance	10 42
„ 24......	III.........	Eclipse, disappearance	11 0
„ 25......	I.........	Transit, egress	11 8
„ 30......	II.........	Transit, ingress	10 23
„ 30......	II.........	Transit, egress	12 48
„ 31......	I.........	Eclipse, disappearance	12 36

SATURN will this month be visible only during the earlier hours of the night, and his altitude then will be but small. He sets, at the beginning of the month, about half-past eleven, and at the end

of it about half-past nine. His place in the heavens is still within a short distance of β Scorpii. He will be in conjunction with the Moon on the evening of the 24th, she being nearly in her first quarter.

OCCULTATIONS OF STARS BY THE MOON.—We have only one such phenomenon to call attention to, that of μ Capricorni, a star of the fifth magnitude, on the 31st. The disappearance and reappearance will take place at 6h. 42m., and 7h. 54m., respectively, the angles on the disc between the highest point and that at which the star will disappear and reappear, 66° and 256°.

NEW PLANET.—A ninety-ninth small planet was discovered at the Observatory recently established at Marseilles, in connection with the Imperial Observatory of Paris, on the 29th of May.

NEW COMET.—A new comet (II., 1868), was discovered by Dr. Winnecke, at Carlsruhe, on the 13th of June. It was also independently discovered the same night at the Marseilles Observatory. During the following night, it was observed by several astronomers, to whom the discovery had been communicated, and described by them as very bright and already furnished with a tail. On the 20th, the tail was more than three degrees in length. The comet was, about that time, just visible to the naked eye, and was, when brightest, comparable to a star of the fifth magnitude. It passed its perihelion on June 26, its distance from the Sun being then about six-tenths of that of the Earth. It approached the latter nearest on June 30, and was then within about fifty-six millions of miles of us. Early in the following month it gradually ceased to be visible.

ENCKE'S COMET.—As this month will be by far the most favourable time for observing this interesting body in our hemisphere, we give the following ephemeris of it, from the calculations of Becker and von Asten,* but reduced to one hour after midnight at Greenwich. The comet is nearest the Earth on August 27, being then 1·23 times the distance of the Sun from us. It will be constantly approaching the Sun, and will, at the end of the month, be almost exactly half the distance from him that the Earth is. It is unfortunate that its time of visibility is limited to the hours after midnight; but those willing to observe it in the small hours, and having good optical means at their disposal, will find it in other respects pretty favourably placed.

* "Astronomische Nachrichten," No. 1692.

DATE.			RIGHT ASCENSION.			NORTH POLAR DISTANCE.	
	d.	h.	h.	m.	s.	°	′
August	1	13	5	35	46	58	10
„	2	13	5	41	56	58	7
„	3	13	5	48	14	58	5
„	4	13	5	54	36	58	4
„	5	13	6	1	13	58	5
„	6	13	6	7	55	58	7
„	7	13	6	14	42	58	10
„	8	13	6	21	37	58	16
„	9	13	6	28	40	58	23
„	10	13	6	35	50	58	31
„	11	13	6	43	7	58	41
„	12	13	6	50	31	58	53
„	13	13	6	58	0	59	6
„	14	13	7	5	34	59	20
„	15	13	7	13	15	59	38
„	16	13	7	21	1	59	58
„	17	13	7	28	51	60	20
„	18	13	7	36	47	60	44
„	19	13	7	44	44	61	11
„	20	13	7	52	44	61	40
„	21	13	8	0	50	62	10
„	22	13	8	8	58	62	42
„	23	13	8	17	7	63	19
„	24	13	8	25	17	63	58
„	25	13	8	33	29	64	37
„	26	13	8	41	42	65	19
„	27	13	8	49	55	66	5
„	28	13	8	58	8	66	53
„	29	13	9	6	21	67	43
„	30	13	9	14	34	68	35
„	31	13	9	22	47	69	29

For the sake of uniformity, we have given all these places for 13h., corresponding to one o'clock (civil reckoning) on the morning of the day following. But although the comet rises soon after midnight at the beginning of the month, it will, towards the end of it, not rise until between two and three hours after midnight, and will gradually cease to be visible in the morning twilight. About the 9th, it will pass from the constellation Auriga into Gemini,

approaching within a short distance Castor and Pollux on the 17th and 18th; and will enter Cancer on the 20th, and Leo on the 30th.*

Brorsen's Comet.—Our distinguished countryman, Mr. Huggins, has made use of the opportunity afforded by the recent return of this comet, to make some additional investigations in spectrum analysis, by means of which have been brought to light, within the last few years, some of the grandest revelations which physical science has ever disclosed to us. We need not here allude to how large a share this astronomer has had in these wonderful discoveries; but will confine ourselves to a brief notice of the examination he has made of the comet in question with the spectroscope, as communicated by himself to the Royal Society. Speaking in the first place of its general appearance as seen by him, he says, "The comet appears in the telescope as a nearly round nebulosity, in which the light increases rapidly towards the centre, where, on some occasions, I detected, I believe, a small stellar nucleus. Generally this minute nucleus was not to be distinguished from the bright central part of the comet. I suspected two or three bright points in the coma. May 7, I perceived a small extension of the faint surrounding nebulosity in a direction opposite to the Sun, so as to form a short tail." Then, as the result of a careful spectral examination, he tells us that the spectrum consisted, for the most part, of three bright bands, but there was also a very faint continuous spectrum. The length of the bands in the instrument showed that they were not due alone to the stellar nucleus, but were also produced by the light of the brighter portions of the coma.

Mr. Huggins had previously examined the spectra of two small comets which appeared in January, 1866, and in May, 1867. They, as well as Brorsen's, exhibited, under prismatic analysis, both a continuous and a discontinuous spectrum, indicating the existence of both reflected and directly transmitted light. But in Brorsen's, the proportion of the amount of the former to that of the latter was much smaller than in the two others. In them, the nucleus only appeared to be self-luminous, and the surrounding coma gave only a continuous spectrum, showing that it owed its visibility to reflected solar light alone. In Brorsen's, on the other hand, the

* We much regret having to notice several errors in the places of the comet as given in the Student for July. By some misunderstanding, the printer, instead of making some corrections in the minutes of right ascension, printed the figures intended for that column in the margin, before the dates. The correct right ascensions for July 11, 16, 21, and 26, are 3h. 52m. 27s., 4h. 12m. 47s., 4h. 35m. 26s., and 5h. 0m. 44s.

bright middle part of the nebulosity around the nucleus seemed to have a constitution analogous at least to that of the nucleus, and to be self-luminous.

The general conclusion appears to be, that the matter of which a comet consists is more or less capable of reflecting the solar light, whilst the nucleus and part of the matter which outstreams from it are in the state of ignited gas, and shine with their own luminosity. As Mr. Huggins remarks,* "Terrestrial phenomena would suggest that the parts of a comet which are bright by reflecting the Sun's light, are probably in the condition of fog or cloud. We know from observation that the comæ and tails of comets are formed from the matter contained in the nucleus. The usual order of the phenomena which attend the formation of a tail appears to be, that as the comet approaches the Sun, material is thrown off at intervals from the nucleus in the direction towards the Sun. This material is not at once driven into the tail, but usually forms in part of the nucleus a dense luminous cloud, into which for a time the bright matter of the nucleus continues to stream. In this way a succession of envelopes may be formed, the material of which afterwards is dissipated in a direction opposite to the Sun, and forms the tail. Between these envelopes dark spaces are usually seen. If the matter of the nucleus is capable of forming by condensation a cloud-like mass, there must be an intermediate state in which the matter ceases to be self-luminous, but yet retains its gaseous state, and reflects but little light. Such a non-luminous and transparent condition of the cometary matter may possibly be represented by some at least of the dark spaces, which, in some comets, separate the cloud-like envelopes from the nucleus and from each other."

We must not omit to mention that Father Secchi, the well-known Director of the Observatory of the Collegio Romano at Rome, has also employed the spectroscope in observing comets, including Brorsen's at the late appearance, with results agreeing generally with those of Mr. Huggins. He states† that the light of this comet was so feeble as to be scarcely equal to that of a star of the seventh magnitude. But as the result of his observations, he says (after giving his measures of the position of the bright bands, made with all the accuracy possible under the circumstances), "It may be concluded at once that the light is not derived solely from

* "Proceedings of the Royal Society," vol. xv. p. 5, "On the Spectrum of Comet I. 1866."

† "Comptes Rendus," tom. lxvi. No. 19.

reflected solar light; that which does proceed from the Sun perhaps constitutes only the diffused basis of the field of view."

THE PERSEIDES.—The Perseides, or August meteors, may be looked for on the nights of the 9th and 10th. The radiant point has been determined to be in R. A. 2h. 44m., N. P. D. 34°, very near the fourth magnitude star, η Persei, whence the name Perseides. About the end of the year 1866, Signor G. V. Schiaparelli, of Milan, made the interesting discovery that their orbit round the Sun was very nearly coincident with that of a small comet known as II. 1862. Similar coincidences were afterwards noticed in reference to the November and April meteors, and much additional interest was thus given to the whole subject of meteoric astronomy. Those who are willing to take part in the observation of those of this month, should make themselves well acquainted beforehand with the stars in Perseus and the neighbouring constellations. They should also prepare for a persevering watch, and not expect a very brilliant display, or to see many *large* meteors.

ECLIPSE OF THE SUN.—From the preparations which have been made for observing the total eclipse of the Sun, which will be visible in India on the 18th of this month, hopes may be entertained of some substantial increase to our knowledge concerning the many points on which such a phenomenon is likely to throw light. We shall have something to say on the subject when the results arrived at are known in this country.

THE MOON.—The Moon is full at 11h. 52m. on the morning of the 3rd. Soon after the beginning of the month, therefore, the Mare Crisium and all the regions near the western limb may be best studied. The last quarter occurs half an hour after noon on the 11th, and the conjunction at 5h. 12m. on the morning of the 18th. On the evening of the 21st the advancing terminator will be over the Mare Crisium, and the regions between the western limb and the centre will successively come into view until the first quarter, which takes place at 12h. 47m. on the night of the 24th. Mr. Birt will, in another place, call the attention of our readers to a communication made to him, by which it would appear that another crater in our satellite is deserving of special examination, it appearing probable that it has undergone some change. It is not far from the Moon's centre, and will be visible on the evening of the 25th.

At the commencement of the second volume of the STUDENT, and particularly whilst speaking of the Moon, we cannot refrain from mentioning the recent publication of the second and improved

edition of the Rev. T. W. Webb's "Celestial Objects for Common Telescopes," which should be in the hands of every amateur astronomer. Observers of the Moon scarcely require any other guide.

ADDENDUM.—Since the above "Notes" were written, Mr. Huggins has published the results of an examination of the spectrum of the lately-discovered Comet, II. 1868. From this, it appears probable, that *carbon*, which constitutes so considerable a portion of the substance of organic matter on the Earth, enters largely into the composition of comets, and shows itself, when they approach the Sun, in a state of incandescence or vaporization. Mr. Huggins thinks there are indications of its existence in both conditions, as shown in the colour of different parts of comets, and considers that some explanation may in a similar manner be afforded of the prevalence of greenish or greenish blue colour in meteors. We have more than once alluded to the theory, now so highly probable, that these bodies consist of the matter of comets, particles of which have been left by them, in a minutely-divided state, along the line of their orbits.

ON THE THAPSIA GARGANICA AND THE SILPHIUM OF THE ANCIENTS.

BY JOHN R. JACKSON,

Curator, Museum, Royal Gardens, Kew.

IT would appear at first thought that scarcely a link could exist between botany and numismatics, but the representations of plants on coins are of very frequent occurrence. Though at the present time pharmacy owes a great deal to botany, as our valuable drugs are nearly all obtained from the vegetable kingdom, yet she includes in her repertories no such marvellous panaceas as her ancient professors laid claim to. So great was the repute of some of the medicine plants of the ancients, that representations of them may be seen as records on some of the antique coins. There are few plants of this class having a greater interest than that from which the most celebrated gum-resin, the Laser Cyrenaicum, was obtained. No medicinal plant, perhaps, was so highly prized as this, which was sometimes called Asa-dulcis, to distinguish it from Asa-fœtida. Much doubt has existed, and, indeed, still exists, as to the true

source of the ancient laser, but some authors have considered it to have been derived from the *Thapsia garganica*, while others have referred it to *Thapsia silphion*, which is perhaps merely a variety of *T. garganica*. An opinion prevailed at one time that the two resins, Asa-dulcis and Asa-fœtida, were identical; but the discovery of the *Thapsia silphion* or *garganica* upset this theory, as it was thought that the rude representations on the reverse of the Cyrenean coins in some measure agreed with this plant. It is not, however, at all improbable that the resin collected by the ancients was obtained from more than one plant, though it may be considered certain that it was the produce entirely of the umbelliferous order. Pliny says, speaking of the *Silphium*, "For many years this plant has not been found in Cyrenaica, because the publicans who rent the pastures, finding it more profitable, destroy it as food for cattle. One stalk only, found in our days, was sent to the Emperor Nero. We may know when cattle meet with young shoots of it by the sleeping of the sheep when they have eaten it, and the sneezing of the goats. For a long time past the only laser brought to us is that which is produced abundantly in Persia, Media, and Armenia; but it is far inferior to the Cyrenaic."

Lindley, in his "Flora Medica," refers to the *Thapsia silphion* as one and probably the principal source of the resin, but he says—"While it may be considered certain that the silphion of Cyrene was yielded by *Thapsia silphion*, it by no means follows that all the silphion came from that species. On the contrary, Pliny ("Hist. Nat.," lib. xxii. c. 23), expressly states that in his time it was chiefly imported from Syria; the worst sort being the Parthian, the Median of better quality, and that of Cyrene altogether lost."

The late Admiral W. H. Smyth procured, in 1816, some roots of what was supposed to be identical with this long-lost classic plant; these were sent to the Dukes of Sussex and Buckingham; they, however, did not survive, but Admiral Smyth received an augmentation to his family arms of a chief argent with the silphium on a mount, vert, as well as the plant itself, as an additional crest.

At the present time the *Thapsia garganica* is much valued in Algeria by the natives as a medicinal plant for the cure of diseases of various descriptions. All parts of the plant are considered of equal value. It is strange, however, that though it is said to possess properties so beneficial to man in Algeria, it is, on the contrary, just as poisonous to camels. Nor has the plant any place in modern pharmacy in this country. It is found in Spain, Greece, and

Southern Europe generally; it inhabits the mountainous parts of the country, particularly that part about the ancient Cyrene.

The extravagant powers attributed by the ancients to this drug is alone sufficient to arouse an interest as to its source. Among the miracles which it worked, those of giving youth to the aged and sight to the blind are not the most wonderful. It cured envenomed wounds, and was a certain antidote for poisons of every description. Like many other drugs of fabulous properties, the standard of its value was estimated by its weight in gold. So great was its reputation, that the Cyrenean princes caused it to be represented on the reverse of their coins, as is seen in the cut.

A Cyrenean coin, showing the *Thapsia* on the reverse side.

The legend KOINON, probably refers to the coin being current by some convention through the whole of the Cyrenaica. The head on the obverse is that of Jupiter Ammon, a common type of these coins, in allusion to the famous temple of Ammon in Libya.

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LAT. 51° 28′ 6″. LONG. 0° 18′ 47″ W.

BY. G. M. WHIPPLE.

(*With a Plate.*)

(BY PERMISSION OF THE METEOROLOGICAL COMMITTEE.)

APRIL, 1868.

ATMOSPHERIC PRESSURE.—We may consider the movements of the barometric column in this month as divided into two periods, each nearly two weeks in duration.

The barometer stood high, 30·362 ins., on the 1st, and, still rising, recorded the highest reading for the month, 30·391 ins., on the 2nd. From this date it gradually fell to 29·412 ins. on the 8th.

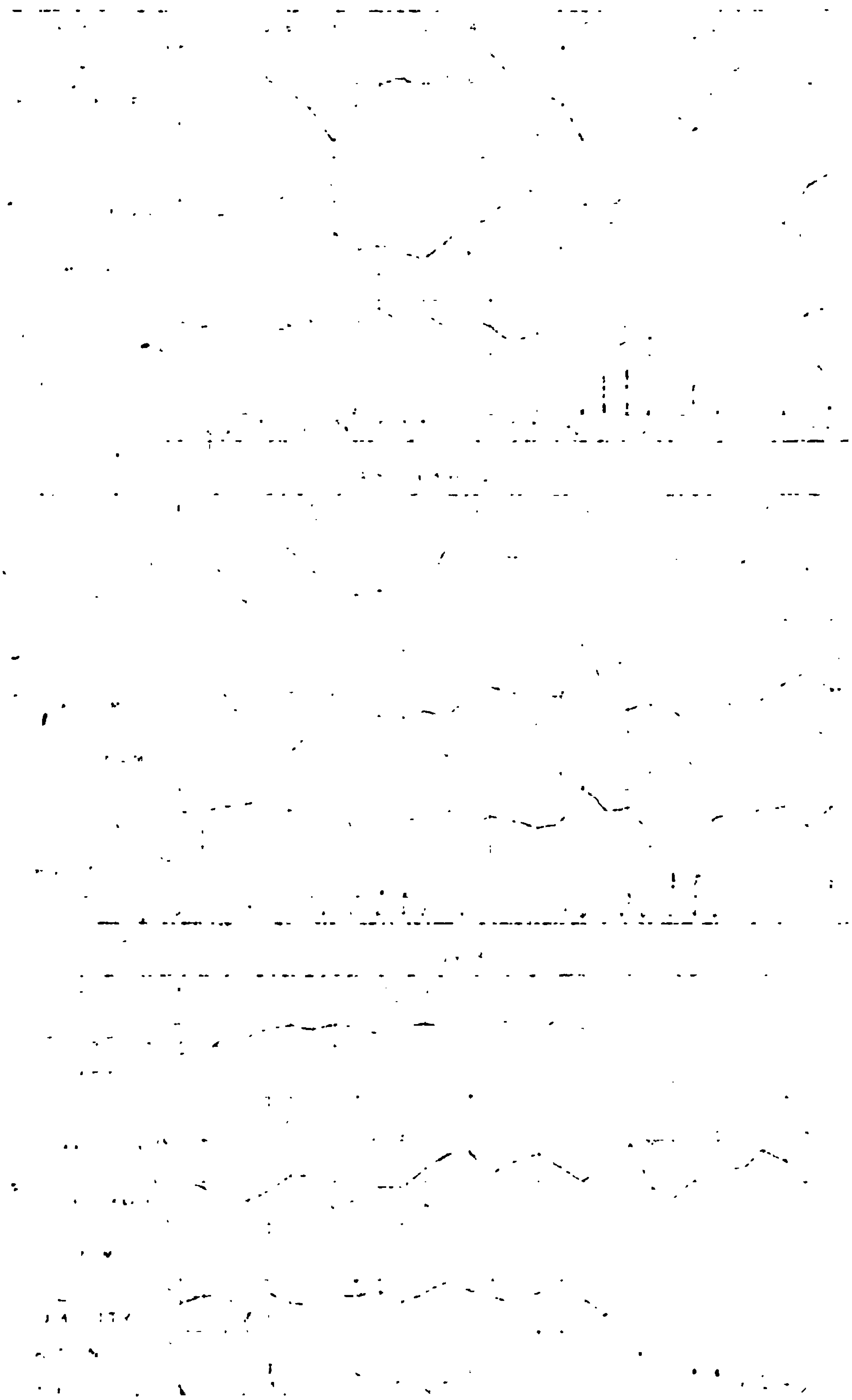
Increasing readings followed to 30·001 ins. on the 10th.

The pressure remained nearly stationary at this point until the 13th. During the two days succeeding it increased, the mean for the 15th being 30·319 ins. From this it steadily fell to 29·831 ins., the mean for the 18th, and continued falling during the 19th. The minimum was reached at 1 A.M. on the 20th. Throughout the day the readings regularly increased until 10 P.M.; then the barometer again assumed a downward movement, which lasted until 6 A.M. of the 21st. The mean for the 20th was the lowest in the month, 29·150 ins.

On the 21st the barometer gently rose to 29·617. After a slow descent, at 8 P.M. on the 24th, a rise began, and continued until noon on the 25th, making that day's mean 30·036 ins. From this time to the end of the month the pressure remained nearly constant. On the 27th, two sudden elevations, or jumps, of the barometric column were registered—one of 0·062 ins. at 4.20 P.M.; the other 0·035 ins. at 8.40 P.M.

The mean height of the barometer for the month = 29·927 ins.

TEMPERATURE OF THE AIR.—This was 48·8° on the 1st, and there was little variation from this until the 8th, which was colder, being 43·3°. The next day the mean stood still lower, 39·7°. At 0·40 P.M. of this day, a sudden fall of temperature of 7° was registered, the thermometer gradually reassuming its former position. At 2.50 P.M., another sudden fall, 4° in extent, occurred; and again, at 5.20 P.M., a similar fall of 4°. The last was not followed by a rise, as the others were.



The 12th was the coldest day in the month, 37·4°; afterwards the temperature rose. At 10.10 P.M. on the 14th the thermometer suddenly fell 5°. The mean for the 16th and 17th was 52·5°, and for the 18th, 46·9°. The succeeding days were warmer up to the 22nd, 54·2°. On the 23rd the thermometer went down 10° between 4 and 5 P.M., and rose 7° before 6 P.M.

The 30th was the day when the mean stood highest in the month, 56·9°.

The maximum temperature reached was 66·4° on the 4th. 64·6° was read on the 5th, and 64·5° on the 30th. The low maxima were 42·6° on the 12th, and 45·8° on the 9th.

The lowest minimum was 29·4° on the 12th; the highest minima 49·6° on the 17th and 22nd.

The greatest daily ranges were 33·7° on the 4th, and 29·7° on the 15th; the least, 6·7° on the 1st.

The mean temperature for the month was 47·8°, and the mean daily range 15·8°.

RELATIVE HUMIDITY.—The month was generally dry; the days when the amount of aqueous vapour in the air was small being the 10th, 12th, 29th, and 30th, when it was 0·58, 0·64, 0·55, and 0·59 respectively; complete saturation being 1·00.

The mean humidity for April = 0·74.

RAINFALL.—The amount of rain measured was as follows:—

DAY.	AMOUNT.	DAY.	AMOUNT.	DAY.	AMOUNT.
8......	0·090 inch.	20......	0·377 inch.	25......	0·020 inch.
9......	·040 "	21......	·420 "	26......	·006 "
10......	·015 "	22......	·025 "	28......	·134 "
18......	·020 "	23......	·034 "		
19......	·063 "	24......	·240 "		

Total fall during the month being 1·481 inches.

WIND.—The general direction was:—

North-East—1st, 8th, 9th, 10th, 11th, 12th, 13th, and 14th.
East—2nd, 4th, 18th, and 25th.
South-East—3rd, 24th, and 26th.
South-West—7th, 19th, 21st, 22nd, 27th, and 28th.
West—20th, 23rd, 29th, and 30th.
North-West—5th, 6th, 16th, and 17th.

The direction of the wind on the 8th changed between 8 A.M. and 10, gradually from South-West to East. At 1.30 P.M. the same day, the velocity of sixteen miles an hour ceased, and it became nearly calm, the direction going from North to East-North-East. At 2.20 P.M. it went back to North, the velocity rising to thirty miles; and the wind continued rough until 6 P.M. on the 9th.

The night of the 14th was very calm, and the direction gradually veered from North-East to South-West. During the 15th it returned to North-East; but, after 7 P.M., it blew again from the South-West.

At 8.40 A.M. on the 18th, the slight breeze blowing from the West changed into an Easterly wind of ten miles an hour. During the 19th and 20th, a brisk wind blew from the South and West; it continued through the 21st at about thirty miles per hour, going down a little in the morning of the 22nd, but freshened again, and remained rough until midnight on the 23rd, after which it gradually decreased. At 6.50 P.M. on the 25th the direction changed from East-South-East to West-North-West, and at 8.40 P.M. to North, veering back to South-West at 1 A.M. on the 26th.

The velocity was about twenty miles all through the 29th and 30th.

MAY.

ATMOSPHERIC PRESSURE.—A slightly rising barometer at the end of the last month brought up the mean for the 1st to 30·261 inches. From this it went down to 29·862 ins. on the 3rd. During the 5th and 6th it remained nearly stationary, the mean for both days being 30·155 ins.; and for several days after the downward movement was very slow. On the 13th it rose somewhat faster, and the reading of 30·311 ins. for the 14th was the highest in the month.

The pressure diminished to 30·043 ins. on the 16th, increasing again to 30·101 ins. on the 17th. After this date the general movement of the barometric column was downwards, steadily for the first few days, but more rapidly in the night of the 22nd, up to 3 P.M. on the 23rd, when the minimum was reached, and it commenced rising. The lowest mean in the month was 29·567 ins. on the 23rd. The readings gradually increased, during the following days, to 30·181 ins. A slight fall occurred to 29·940 ins. on the 29th, and the record for that day shows the barometric column to have been in a state of continual tremor, or small oscillations, for some hours, at the time of the passage of a thunderstorm over it. Subsequently, the readings rose to 30·058 ins. on the 31st.

The mean height for the month = 29·982 inches.

Temperature of the Air.—From 55·0° on the 1st and 2nd, the temperature rose to 59·8° on the 3rd. After this the thermometer gradually went down to the 6th, which was the coldest day in the month, the mean being 45·6°. On the 8th it had returned again to 59·6°. After this there was but little change until the 19th, which day was unusually hot—the warmest during the month, the temperature being 71·2°. The following day the thermometer was down again to 60·1°, and the next day still lower, 55·6°. At 9.30 P.M. on the 23rd, the temperature suddenly fell 3°, rising again soon after to its former reading. From 51·3° on the 24th, a gradual increase took place to 64·3° on the 29th. This day's record of thermometric changes was very irregular, and two sudden falls of 4° were recorded—one at 1.40 P.M., the other at 4.5 P.M.; both occurred during thunderstorms. The temperature on the 30th and 31st was 60·3°.

The highest readings of the maximum thermometer were, on the 3rd, 78·8°; 19th, 83·0°; and 28th, 75·9°. The lowest readings of the same instrument were 55·1° and 53·7° on the 5th and 6th.

The highest minima recorded were 53·9° on the 19th, 55·8° on the 20th, and 54 9° on the 29th.

The greatest daily range was 36·8°, on the 8th; the least 8·9°, on the 23rd; the mean for the month being 20·3°.

The mean temperature for May, = 56·9°.

Relative Humidity.—This varied more in May than in the preceding month, the days on which least aqueous vapour was present being the 19th, 8th, and 30th, when it was 0·45, 0·56, and 0·56 respectively. The days of greatest moisture were the 22nd, 0·91, and 23rd and 24th, 0·94 (complete saturation being 1·00).

The mean for the month = 0·72.

Rainfall.—The rain measured was :—

DAY.	AMOUNT.	DAY.	AMOUNT.	DAY.	AMOUNT.
9......	0·042 inch.	22......	0·035 inch.	25......	0·157 inch.
10......	·081 "	23......	·082 "	30......	·135 "
11......	·030 "	24......	·203 "		

Total fall during May, = 0·765 inch.

Wind.—The general direction was :—

North—16th and 30th.

North-East—4th and 17th.

East—5th, 6th, and 18th.
South-East—2nd, 7th, 8th, 28th, 29th, and 31st.
South—11th, 20th, and 25th.
South-West—3rd, 9th, 10th, 12th, 13th, 14th, 15th, 20th, 21st, 22nd, 23rd, 25th, 26th, and 27th.
West—1st.

The greater part of May was very calm, the wind, blowing at twenty miles per hour at the end of the last month, calmed down at 10 P.M. on the 2nd. On the 3rd, at 8.45 P.M., a breeze of fourteen miles sprang up from the N.N.E., the little wind through the day having been from the S.W. During the 6th the velocity was between twenty-five and thirty miles per hour. From the 7th to the 22nd, very little motion of the wind was recorded, especially at night. The 23rd had a wind of twenty-five miles, as did also the 25th. On the night of the latter, the wind decreased in velocity, and from 6 to 7 A.M. on the 26th it was a perfect calm.

The light winds through the night of the 29th blew from all quarters, North to South to North.

JUNE.

ATMOSPHERIC PRESSURE.—The pressure throughout the greater part of this month remained unsually constant.

The reading on the 1st was 29·943 ins., and the barometer remained at that point until 4 P.M. on the 2nd; from which hour to 10 P.M. it gently rose about one-tenth. The next day's readings were a little lower; but, on the morning of the 5th, from 1 A.M. to 8 A.M., there was an upward movement, bringing the mean for that day to 30·140 ins. From this date to the 16th the variations did not exceed 0·08 inch. During the evening of the 16th the barometer fell, so that the reading for the 17th was 30·153 ins. It rose again from 8 P.M. to midnight. The readings gradually diminished through the 19th, and shortly after midnight the barometer became much disturbed. Its general movement had a downward tendency; but, at 7.50 A.M. of the 20th, a very rapid upward movement of 0·06 in. took place; and at 9 A.M. a similar, although somewhat less rapid, movement apparently brought it back to its former position. At noon another rapid rise, smaller in extent than the previous one, was recorded. The corresponding descent occurred at 3 P.M.

Through the night the barometer steadily fell, and up to 9 P.M. of the 21st; but here a sudden rise of 0·05 in. was registered, to which we do not find a corresponding fall. It remained low all the

22nd, the mean for the day being 29·683 ins., the lowest in the month. There was a little increase in the readings on the 23rd, but after 7 P.M. a decidedly rising barometer set in, which lasted all through the 24th and 25th, bringing the mean for the 26th to 30·313 ins. Very slight changes occurred afterwards. The 29th mean was the highest in the month, 30·318 ins.

The mean height for June = 30·122 inches.

TEMPERATURE OF THE AIR.—The first part of the month witnessed a falling thermometer, the readings diminishing from 60·0° on the 1st to 55·4° on the 4th. The thermograph curve for that day had two peculiarities: it recorded a perfectly stationary thermometer from 4 to 11 P.M.; at 11.15 P.M. it fell 5°, and then remained constant until 3 A.M. of the 5th. The thermometer rose during the 5th and 6th. On the 8th the temperature was lower, the mean for the day being 53·6°, the lowest in the month. Afterwards the readings increased gradually to 67·2°, on the 14th. The mean for the next day was less, 62·3°. The following days were warmer, but the 19th was only 59·7°. On the 20th the thermometer rose rapidly till 11.30 A.M. It then fell until 2 P.M. to 70°, where it remained, till at 5 P.M. it commenced rising, reaching the maximum temperature at 6.30 P.M. The 21st had the highest mean for the month, 69·9°. On the 23rd it had decreased to 55·6°, but afterwards gradually went up to 68·1° on the 27th. The means for the 29th and 30th were 58·6° and 62·2° respectively.

The highest readings of the maximum thermometer were—13th, 80·8°; 14th, 80·2°; and 27th, 85·0°. The lowest maxima were 60·7° on the 4th, and 62·3° on the 8th.

The highest minima were, 21st, 56·6°; 25th, 56·5°; and the 28th, 58·8°. The lowest, 42·5° on the 8th, and 44·3° on the 10th.

The extent of daily range was 35·1° on the 27th, and 30·0° on the 13th; the smallest ranges being 11·9° on the 4th, and 14·4° on the 21st.

The mean temperature for June was 61·2°; the mean daily range, 21·8°.

RELATIVE HUMIDITY.—The month was unusually dry, the days of greatest dryness being the 13th and 27th. On these days the amount of moisture present in the air was 0·48 (complete saturation 1·00). The greatest humidity was registered on the 4th, 0·95.

The mean during the month was 0·64.

RAINFALL.—The only measurements of rainfall were :—

5th	0·097 inch.
21st and 22nd . .	0·171 „

24th . . . . 0·122 inch.
25th . . . . 0·004 „

Giving a total of 0·394 inch for the month.

WIND.—The general direction was:—

North—14th and 18th.
North-East—20th, 26th, 28th, 29th, and 30th.
East—19th.
South-East—1st and 21st.
South—22nd.
South-West—4th, 6th, 23rd, and 24th.
West—3rd, 7th, 10th, 25th, and 27th.
North-West—2nd, 5th, 8th, 9th, 11th, 12th, and 13th.

During the morning of the 2nd, the direction changed from South-East to North-West; and at 11 P.M. on the 4th, from South-West to North. At 7 A.M. on the 6th, the velocity rapidly augmented from three to sixteen miles per hour. The night of the 12th was very calm. The apparatus for recording the direction was out of order, and under repair from the 14th to the 18th; the direction of the wind for those days is accordingly wanting. During the 19th the velocity was between twenty-five and thirty miles per hour. In the morning of the 20th the wind veered from North-East through South to North-West, returning back to East at 10 A.M. On the 21st a southerly wind blew at twenty miles per hour, which diminished to three miles in the evening. There was a perfect calm from 4 to 5 P.M. on the 23rd, and very little wind was registered until 7 the next morning. Between 26th midnight and 5 A.M. on the 27th, only four miles of wind were registered as having passed over the instrument. At 6 A.M. a light breeze of eight miles per hour came up from the West, the direction the previous evening having been North-East.

ARCHÆOLOGIA.

EARLY in the spring of the present year an interesting ROMAN SEPULCHRAL INTERMENT was accidentally discovered at Bexhill, near Milton, in Kent. It consisted of a leaden coffin, an object which is so frequently met with in Roman burial-places in this island, which was six feet two inches long, by two feet five inches wide, and thirteen inches deep. A perfect skeleton, which appeared to be that of a man, was found inside, which was accompanied by one of the small slender glass bottles usually called lacrymatories. Another glass vessel, of a jug-form, was found outside the coffin. The leaden coffin had, at the time of interment, been partly filled with quick lime, and it appeared to have been enclosed in a wooden chest, as decomposed wood and iron bolts were found scattered about.

A ROMAN LEGIONARY TABLET has been found in the parish of CARRIDEN in Linlithgowshire, on the line of the wall of Antoninus. The stone is nine feet long, by nearly three feet in breadth, and is divided into three panels, the central one containing an inscription to the emperor Antoninus Pius, and a statement that 4652 paces of the wall in that neighbourhood had been the work of the second legion. The other two panels are filled with sculptures in alto-relievo. That on the left represents a Roman horseman riding over the bodies of fallen Caledonians; the subject of the other is a sacrificial scene, the priest standing behind the altar, with attendant figures, and the victims, a ram, a bull, and a pig, in the foreground. This stone was found on a small rocky eminence called Windmill Hill, which juts into the level sea-shore land immediately above Bridgeness harbour, and must have been surrounded on three sides by water during the Roman period; and the discovery of the legionary stone would seem to identify it as the place of termination of the wall at this end.

A MOSAIC PAVEMENT has been recently discovered near the castle AT CHESTER, remarkable chiefly for the following inscription, which is worked in the centre.

C.VTI.L.A.R.
PESCENNINI.

This is supposed to be the name of the owner of the Roman house to which this pavement formerly belonged, which may be read in full Caius Utius Pescenninus, or Pescennianus, who was probably related to a family at Æsernia in Italy, one of whom was called Quintus Utius Pescennianus, and another Caius Utius.

Some interesting ANGLO-SAXON REMAINS have been found by Mr. W. Ponting at UPTON SNODBURY, near Worcester, on what is evidently the site of an Anglo-Saxon cemetery, perhaps of the sixth century. They consist of the usual large two-edged sword, and heads of spears or lances, some of which, to judge by the photographs we have received, may probably have been arrow-heads; a number of fibulæ, beads, etc. The beads, which were of amber, with two of terra-cotta, beautifully coloured and striped, formed a complete necklace. Some other amber beads were found near, but not with, the necklace. Two of the fibulæ are cup-shaped, or saucer-shaped, of the description which appears to have been peculiar to the West-Saxons. This is important, because, in this part of the island, two branches of the Anglo-Saxon race, the West-Saxons and the Mercians (Angles), overlapped each other in the settlement; and the character of these remains would seem to show that Worcestershire was occupied by a West-Saxon population before it was taken possession of by the Mercians. There were also found a large, finely-ornamented fibula of the cross-shape, and two smaller cross-shaped fibulæ, all belonging to well-known types. Among the contents of this grave (for it no doubt had been a grave) were two balls of crystal, of a description found not unfrequently in Anglo-Saxon interments, under circumstances which have led to the supposition that these balls were symbols of authority in the individuals who were buried there. There was found likewise what our correspondent calls "an amber charm," perforated with three holes; and a beautiful large glass bead of various colours, the latter now in the possession of Mr. R. Berkeley, jun.

Gloucestershire and the West of England evidently formed the fashionable part of Roman Britain, which was not only covered with handsome towns, but was thickly scattered with magnificent villas. One of these, an extensive ROMAN VILLA at CHEDWORTH, one of the valleys of the Cotswolds, was discovered some three or four years ago, and partially excavated. It has been further explored quite recently; but a great part of it still remains to be brought to light. This villa was situated in a beautiful and secluded spot, closed in by the slopes of the hills on three sides, and on the other looking down the vale upon the River Coln—the parent stem of the Thames. It appears that, like most of these large Roman villas, the state-apartments, if we may so call them, occupied one end of an interior court, along the sides of which ran the masses of domestic buildings. Some of the rooms—that is, the floors and lower parts of the walls—were found almost perfect, and presented many

interesting features. One room contains a remarkably bright and beautiful mosaic pavement, the central compartment of which is divided into divisions, containing dancing figures in various attitudes. At the four corners, in triangular spaces, are figures representing the four seasons. Another mass of buildings contained the baths, many parts of which, with their pavements, are also well-preserved. In another part there is what appears to have been a pleasant inclosed space, open to the air, with a fountain in the centre. This inclosure has been supposed strangely enough to have been a baptistery.

In the last number, recently published, of the "Journal of the British Archæological Association," there is an interesting paper, with illustrations, on this Chedworth Villa, by Mr. J. W. Grover, one of the Members of the Council of the Association, who has taken an active interest in the explorations; a paper which may be recommended to our readers. Mr. Grover seems to adopt this notion of the baptistery, and to suppose that this villa was an early Romano-British Christian establishment, from two or three circumstances which, we fear, form but very weak evidence. Among its ornaments, as well as in the well-known Frampton pavement, what is called the Christian monogram has been found, and some stones with crosses upon them, which are supposed, without any reason whatever, to have reference to Christianity; but, much more than this, the letters PRASIATA (which, to judge by the engraving, we are not sure should not be read PRASTATA), are considered as referring to Prasiatagus, the husband of Boadicea; and the letters ARVIRI, found on some Roman bricks, are interpreted as referring to Arviragus, the British king, who is pretended to have been converted to Christianity by Joseph of Arimathea. We fear these interpretations would not stand long before a scholar in the nomenclature of Roman inscriptions in Western Europe. As to the monogram, which belonged to the *labarum* of the Roman Empire after Constantine, its presence in such positions, amid Pagan ornaments and emblems, is explained without any difficulty. Our knowledge of the condition of this distant Roman province is sufficient to leave no doubt in our minds that Christianity made little progress in Roman Britain, and that it was not established here during the Roman period. All our discoveries show Roman Paganism existing here down to the period of the withdrawal of the Roman power. Christianity was, of course, known, and Christians must have visited the island; but, independent of this, an ornament of the imperial standard might be adopted by anybody; and there were, no doubt, philosophers who considered

Christianity as one of the existing forms of religious belief, and, without being advocates of it, would affect to place its emblems among those of other religions. Our own impression is, that these characteristics of the Villa at Chedworth belong to a late date, rather than to an early one.

However, a very good opportunity will soon be offered of visiting the remains of this very remarkable Roman villa, as the BRITISH ARCHÆOLOGICAL ASSOCIATION will hold its congress this year at CIRENCESTER; and Chedworth (we believe some seven or eight miles distant from that town) is set down for one of its excursions. T. W.

PROGRESS OF INVENTION.

APPARATUS FOR WARMING AND VENTILATING BUILDINGS.—**It seems strange that the entire heat of a fire is not more frequently utilized and rendered effective in promoting a circulation of fresh air in a room. An arrangement to effect both these objects is very simple, as is shown by the invention of Mr. R. George, of Kilburn. It consists of an iron outer case, either of cast or sheet iron, supported on legs; an open fire-box or stove is placed at the lower part, and within the outer case a box, air being admitted for supporting combustion through a grate of bars below, and a pan to receive the ashes is placed underneath. The products of combustion from the fire-box or stove, after entering within the outer case, together with the impure air drawn from the apartment to support combustion, pass through a pipe or flue (furnished with a regulator at the back of the case) into a chimney. Fuel is supplied to the fire through a fire-door arranged in the front part of the outer case, or in any other way which is found to be more convenient. A coil of pipe about four or five inches wide is arranged around the interior of the outer case above the fire-box; the lower end of this pipe passes out through the lower part of the case, and is so arranged as to communicate with the atmospheric air outside the room or building to be heated and ventilated.** The upper end of the coil of pipe passes out at the top or upper part of the outer case where it is in communication with the interior of the room. The heat from the fire-box or stove is sufficient to warm the coil of pipe, and to cause the circulation of a current of air through it from the outside to the inside of the room; and by this means sufficient heat is imparted to the air, without deterioration or loss of oxygen, by contact with the heated surface of the pipe, the exterior of which, together with the inner surface of the case, soon becomes coated with carbon from the smoke and products of combustion, thus protecting the inlet pipe and

case from being overheated. The form and size of the apparatus may vary, and the outer case may be covered with wirework, or may be ornamented.

Manufacture of Pressed Leather.—The cuttings of leather and tanners' fleshing-pieces are at present utilized by being made into sheets with some adhesive substance, such as glue or paste made of flour and water; but leather so made is liable to the objection that it is affected by damp. Mr. F. J. Bugg, of Ipswich, has invented a process for the better accomplishing this object; he uses in his manufacture a cementing material, not soluble in water, and this he dissolves in a suitable solvent. India-rubber, gutta-percha, or shellac may be advantageously employed, and the solvents which he prefers to use are turpentine and naphtha. However, he claims the use of other cementing substances, insoluble in water, as suitable solvents for them. He moistens the leather scraps with the cement, and then presses them together by means of heavy pressure; and in this way a very lasting material is produced.

Manufacture of Alumina and Salts of Alumina from Blast Furnace Slag, by W. Crossly and T. C. Hutchinson.—This invention consists in an improved process for the manufacture of alumina and salts of alumina by means of the decomposition of blast-furnace slag and other silicates of alumina. The slag or silicate is first subjected to the action of hydrochloric acid, the mixture is then evaporated to dryness, and the soluble chlorides dissolved out. The alumina is thus left mixed with the silica, and may be easily dissolved by an acid, and separated from the silica by filtration. The salt of alumina thus produced is then separated in the usual way by evaporation and crystallization. As an example of the method by which this process is carried out, the treatment of Cleveland blast-furnace slag in the manufacture of sulphate of alumina is described. The slag to be operated upon is first reduced to powder, and then placed in a proper vessel, hydrochloric acid (usually an equal weight) is added, and the mixture allowed to stand until the whole of the slag is quite decomposed; the decomposition being assisted by heat if required. The product of this action is then evaporated to dryness, and washed until all the soluble chlorides are dissolved out; the insoluble portion, which consists of silica and alumina, is then treated with sulphuric acid, and the sulphate of alumina thus produced is separated from the silica by washing, and may be obtained by evaporation, and crystallized in the usual way; or, as a crude salt, may be obtained by merely adding the acid and crystallizing, without removal of the silica.

Treatment of Malt Solution for Brewing, by Edward Belknap.—This invention consists in the use of reagents added to the solution of malt, which have a greater affinity for the nitrogenized compounds, such as gluten and albumen, than for the sugar of the wort, and form with them insoluble bodies, which coagulate, and settle to the bottom of the solution as a dense precipitate. Mr. Belknap uses for this purpose sul-

phate of barium or sulphate of calcium. After precipitation, the wort, thus freed from the nitrogenized substances, is hopped, boiled, and fermented in the usual way; although he prefers to use sulphate of barium or sulphate of calcium, he claims the use of any other sulphate or hydrate which will effect the same object. The proportion in which the baryta salt is to be used is one ounce to the gallon of wort; but if a lime salt be employed, enough should be added to give the blue colour to red litmus paper.

Converting Iron Cuttings into Blooms.—One always hails with pleasure the utilization of any waste as so much gained; cotton waste, paper fragments, the washings from woollen factories, have been redeemed from the sewer and the rubbish heap to repay the energy of the inventor, and to supply rising wants with cheap and useful materials; railway grease is in great part supplied by products of the working out of the last of these inventions, and now a very simple and efficacious method of utilizing the abundant refuse of the machine shop, has just been patented by Mr. Edward Hammond Bentall. Iron cuttings, borings, or turnings are placed in cases of sheet-iron, capable of containing about one hundred weight of the waste iron; the case, when filled, is submitted to the heat of a reverberatory furnace. When brought to a white heat, it is stamped with stampers or put under severe pressure, which, owing to the highly-heated and partially-softened state of the metal, will convert it into a solid plastic mass or bloom, possessing a fair grain, and which is capable of being employed for a variety of purposes.

Coating and Uniting Metals.—This invention has for its object the causing one kind of metal or metallic alloy to unite with another metal or alloy. The metals or alloys are brought together whilst in the molten state, by casting or pouring one over the other into moulds, so as to form articles of any desired shape, which afterwards simply require dressing and finishing to be ready for use. Ingots or blocks to be afterwards hammered or rolled out can be made in the same way. The inventor, Mr. John Patterson Smith, has found that he can in this manner cause the two metals so to commingle at their point of junction, that it is impossible to separate them by any mechanical means, and that a coating of expensive metal or alloy of any desired thickness can be given to an inferior metal.

Insulators for Pianofortes.—The deadening effect which carpets produce on sound is well observed by the difference in the loudness of the tone of a pianoforte when played in a carpeted room or when standing on the flooring boards. Mr. R. W. Pearse has patented a sounding-board, which not only remedies the defect produced by the carpet, and which has been already overcome, to a great extent, by the use of glass stands for the legs of the piano, but gives an increased fulness of tone and greater resonance than can be obtained in any other way. He applies the principle of the body of a violin to his invention, and has ingeniously

effected an application of it, which will doubtless be fully appreciated by those who perform in large buildings, as well as by musicians in drawing-rooms and private houses. He describes his invention as consisting in the main of an apparatus for developing and extending the power or sound of pianofortes, harmoniums, organs, or other similar keyed instruments, whereby the tone of the instrument is considerably strengthened, and the effect of a carpeted room, which it is known materially deadens the sound, is completely counteracted. The apparatus consists of a hollow case of wood or other material, made of the width of the pianoforte or instrument, so that its feet may stand on the margin. The case is made somewhat on the principle of the violin, and stands on four blocks of ebonite, vulcanite, or other non-conducting material, and is at an elevation of about an inch and a half from the floor. The upper surface of the case is of a convex form, and perforated with six or more holes, and between each hole, on the inner side of the case, a sounding-post is fixed. By the application of this apparatus to the feet of pianofortes, it is evident that the vibrations of the musical sounds will be materially increased, and the tone of the instrument thoroughly developed. The apparatus is also serviceable on a stage or in a concert-room, acting as a perfect insulator of sound between the instrument and the floor, and causing the entire power of its sound to be given out, instead of its being partially absorbed by the conduction afforded by the contact of its feet with the carpet or floor.

Grosvenor's Improved Non-explosive Lamp.—The explosions which occur in parafine and other similar lamps, result from the volatilization of the oil at a low temperature; the vapour mixes with atmospheric air above the surface of the liquid within the vessel or the reservoir, and as three gases, ready to unite at the proper temperature, are mixed together, when a light is applied this union takes place and an explosion is the consequence, together with the ignition of the oil, which is scattered in all directions, setting fire to any inflammable substance on which it may happen to fall. It is quite clear that if atmospheric air, and therefore oxygen, be kept out of the reservoir, no explosion can take place, and to affect this object many kinds of lamps have been constructed. Mr. Cyrus Grosvenor, of New York, has invented a very simple lamp, and one which seems likely to prevent any explosion from taking place. All the joints of his lamp are made tight by soldering or brazing; the end of the shaft for raising the wick, which usually passes through the side of the burner, is supported in a close socket inside the shell, and the other end passes through a stuffing box, so that no air can get into the lamp at either of these places, an arrangement being made for renewing the stuffing from the outside. After describing his invention, Mr. Grosvenor says, "With this burner, as the vacuum made in the oil reservoir by the consumption of oil cannot be supplied with atmospheric air, it must, necessarily, be supplied with nitrogen gas, or any uninflamma-

ble gas generated by combustion, as carbonic acid. As oxygen and nitrogen are separated by combustion, and the oxygen is consumed in the process, the liberated nitrogen necessarily descends by atmospheric pressure through the interstices of the wick in sufficient quantity to supply the gradually extending vacuum, even to the entire exclusion of the oil, when the reservoir will be filled with this anti-phlogistic gas, in which even a lighted match will not burn for an instant. As there is no orifice for ventilation, evaporation from within is precluded except through the tube to the flame, where it can be profitably used, consequently no oil can gather on the outside of the lamp to soil fingers or clothing, or to invite external ignition and consequent internal explosion.

Treating Wood for Covering Walls, etc.—Among recent American inventions there is one, which, from its simplicity and general application, deserves attention; wherever it is necessary to use wood in thin sheets its employment will be beneficial. The invention consists in saturating the wood with glycerine. Glycerine and water, mixed in the proportion of about one part of the former to two or three of the latter, is found to be the best mixture. Thin sheets of wood are soaked in this mixture, and placed where the water may evaporate slowly, the glycerine will remain in the wood and will render it permanently soft and pliable. The amount of glycerine to be mixed with water, will, however, vary according to the hardness of the wood to be saturated, but the proportions already given answer well in most cases, in some, glycerine alone can be employed with advantage.

LITERARY NOTICES.

Collectanea Antiqua, Etchings and Notices of Ancient Remains, illustrative of the Habits, Customs, and History of Past Ages. By Charles Roach Smith. Vol. VI., Parts III. and IV.—These parts complete the sixth volume of a collection of papers on archæological subjects which, though put forward very unpretendingly, are of extreme value to the antiquary and to the historian. Charles Roach Smith is, beyond any doubt, the first authority on our earlier national antiquities, especially on those of the Roman and Saxon period, and these six volumes give us some of the principal results of his researches and experience during a large portion of a life of singular activity. When the first part was commenced, at the beginning of the year 1843, the science of archæology in this country was only beginning to raise its head after a very long period of something worse than neglect. Mr. Smith was the principal labourer in the work of revival; it was he who chiefly contributed to the foundation of the Archæological Association, which, during its subsequent career, has done so much to promote the study of antiquities in this country; and he was well known as a writer of valuable articles on anti-

quarian subjects in the transactions of societies and other periodical publications. But in these he was too often confined to subjects of a narrower and rather temporary interest, and in which he was obliged to defer to the tastes and judgment of others, on whom their publication depended, and who sought pictorial effect and popular writing rather than truth and accuracy. He, therefore, determined to start in a path in which he would be left free to act and think for himself, and with the aid of a few zealous artistic friends, he would be able to give, without the control of others, whatever number of illustrations he considered necessary. It was under the influence of these feelings, that in the year 1843 Mr. Roach Smith commenced the publication of his "Collectanea Antiqua." It was intended to be published, not periodically, but occasionally, according as subjects of sufficient importance presented themselves, or as his other occupations allowed him time to study and write, and accordingly, the first volume, consisting of four parts, was only completed in 1848. The second volume was completed in 1852. Down to this time, Mr. Smith's "Collectanea Antiqua" was literally *published*, and though it was nominally published by subscription, it might be obtained through an ordinary bookseller. At the conclusion of the second volume, however, he informs us that he found the sale not sufficient to justify him in continuing the publication, at least, on the same plan, and he felt it necessary, either to find another, or discontinue it altogether. The plan he chose was to allow it no longer to be offered for sale, but to print it for subscribers only. The result was a very much enlarged list of subscribers, and he was enabled to proceed with so much more freedom, that the third volume, though somewhat larger than the others, and very copiously illustrated, was completed in two years, the fourth part appearing in 1854. The fourth volume was completed in 1857; the fifth in 1861; and the two concluding numbers of the sixth volume have been now delivered to the subscribers in the earlier part of 1868. Thus the publication of the "Collectanea Antiqua" has extended over exactly a quarter of a century.

This little history is worth recording, as showing the difficulties which the soundest scholars have not unfrequently encountered in the attempt to lay the results of their labours before the public, and how these may be overcome by the talent and energy of an individual.

It would be impossible for us here to give anything like an account of the varied contents of these six volumes, with very few exceptions the productions of Mr. Roach Smith's own pen, and always from his own personal observations and researches; and although, from the mode of publication adopted, complete sets are found so rarely for sale that they realize large sums of money, yet the influence it has exerted on the progress of archæological science has been very considerable. Nor has this influence been confined to our own country, for Mr. Roach Smith has carried his antiquarian excursions into France and into Germany, and the most distinguished of the French antiquaries acknowledge the excellence

of the articles on the Roman and Frankish antiquities of Gaul which have appeared in the "Collectanea Antiqua."

These papers on the antiquities of Gaul—Roman and Frankish—are to be reckoned among the most interesting of the contents of Mr. Smith's six volumes; and we must not forget that the very first volume contains accounts, with engravings, of Frankish antiquities which Mr. Roach Smith was the first to describe and identify, and some of the French antiquaries have made full use of his labours without due acknowledgment. The papers on French antiquities in the sixth volume are more numerous and more interesting than in any of those which preceded. We may point out especially the paper on the sculptures from Vaison, and the account of the recent researches and discoveries in France, printed in this concluding part of the volume, among which the account of the Roman theatre and temple at Champlieu, and of the newly-discovered Roman town at Mont-Berney, from Mr. Smith's own survey, are particularly worthy of attention. None of these papers, however, are, perhaps, more worthy of our attention than the series allotted to Roman monuments illustrative of social and industrial life. The subject was commenced in Vol. V., where we are presented with numerous engravings of monuments of this description, illustrating different trades, manufactures, and arts. In the first part of Vol. VI. we have a sculpture representing a Romano-Gaulish travelling carriage, carrying passengers inside and outside, somewhat in the manner of our old stage-coaches; and another representing the shop of a vendor of wine and grain; both singularly curious, no less for the subject itself than for the manner in which it is treated. We would also call particular attention to papers in the sixth volume on the Archæology of Horticulture, in which Mr. Roach Smith traces from the earliest times the history of the cultivation of the vine and other fruits in our island. In the parts of the "Collectanea Antiqua" which have just appeared there are two papers relating to discoveries of very great interest recently made in this country. The first makes public the discovery and exploration of a very extensive early Anglo-Saxon cemetery at Kempston, in Bedfordshire; the other is an account of a quantity of Roman fictilia, of very extraordinary character, discovered at Colchester.

In conclusion, we can only say that we heartily hope that the sixth will not be the last volume of the "Collectanea Antiqua," but we trust that Mr. Roach Smith will meet with sufficient encouragement to enable him to carry on, with the same earnestness which is shown in all that has yet appeared, a work so rich in valuable materials.

The Insect World: Being a Popular Account of the Orders of Insects. Together with a Description of the Habits and Economy of some of the most interesting Species. From the French of Louis Figuier, Author of "The World before the Deluge," "The Vegetable World," "The Ocean World," etc. Illustrated by 564 woodcuts, by M. M. E. Blanchard, Delahaye, after Réaumer, etc. (Chapman and Hall.)—This handsome

and elegant volume belongs to a class which deserves a sympathetic rather than a critical treatment from reviewers. In any book ranging over a large subject, and compiled from a variety of sources by a popular writer some errors must be expected, and we must not be surprised if the best and latest authorities have not always been followed. It would be easy to point out details—as, for example, in the microscopy of "The Insect World," where numerous faults of this kind has been committed, but judged fairly and as a whole, it will take its place among the most attractive and useful efforts to spread a general knowledge of an important and fascinating branch of natural history. The style is pleasing, the illustrations of considerable beauty and merit, and the topics are selected with judgment and skill. It is, in fact, one of those books which we always welcome as contributions to a good family library, and as sure to assist in cultivating tastes from which permanent pleasure and profit will be derived. "The Insect World" commences with an introductory chapter on the structure of insects, and then the aptera, the diptera, the hemiptera, the lepidoptera, the orthoptera, the hymenoptera, the neuroptera, the strepsiptera, and the coleoptera are treated in succession, the plan being to select the most interesting insects from each division, and to illustrate their aspects, habits, and structure, by descriptions, anecdotes, and excellent woodcuts, occasionally supplemented by full-page plates. The short chapter on the strepsiptera was added, together with a few notes by "Y. D.," by whom the translation was revised. A large proportion of the insects described can be seen and watched in this country, a circumstance that will enhance the value of the work, and make it a good companion for the garden or the field observer.

Among the matters not generally known, and alluded to by M. Figuier, is the dangerous character of one of the diptera, *Lucilia hominivorax*, to human beings, and especially to those consigned by the benevolence of the French government to the swamps of Cayenne. It appears from the researches of M. Charles Coquerel, that this fly will lay its eggs in the mouth or nostrils of a sleeping convict, especially a drunken one—a class we should have thought not allowed—and that the offspring in their larval state usually bring about the death of their victim. Our readers will recollect that to the same order, the diptera, the Tsetse fly belongs, whose minute drop of poison works such marvellous effects in the destruction of cattle as Dr. Livingstone records. Most of the other insect plagues of cattle belong to the same division. When speaking of the hemiptera, M. Figuier remarks upon the blunders made by La Fontaine, in his well-known fable of "La Cigale and La Fourmie." He makes the cicada sing out through the summer, though it lives only a few weeks, and when the "bise" arrives, that is about November or December, long after it has been dead, he represents the creature as in want of food, and obtaining from the ant some grain to eat. "The ant," says the writer, "is carnivorous, and, although it

likes honey, it has nothing to do with a grain of wheat, nor with any other grain, of which, according to the fabulist, it had laid up a stock. On the other hand, the cicada, which he blames for having

"'Pas un seul petit morceau
De mouche, ou de vermisseau,'

never dreamt of such victuals, for it lives entirely on the sap of the larger vegetables." Other fables of the same author are said to be filled with similar blunders.

In the course of the interesting chapter on lepidoptera, a good account is given of various silkworms and sericulture; and passing from species useful to man, the writer describes the Vine Pyralis—a little moth which commits great ravages on the leaves and young shoots of that plant, to such an extent that in the twenty-three communes of the two departments of the Saone et Loire and the Rhone their destruction was equal to seventy-five thousand hectolitres of wine in one year, valued at one million five hundred thousand francs.

Under the head of coleoptera, some remarkable accounts are given of the ravages of cockchafers on the Continent, and of the public arrangements for their destruction. In 1479, a curious trial of the dreaded insects took place at Lausanne, before the ecclesiastical tribunal of that town. They were defended by an advocate, but, notwithstanding his eloquence, condemned to banishment. Although the court was composed of priests, the cockchafers braved excommunication, and declined to go away. A similar funny story is told in the chapter on orthoptera, of the monk Alvarez trying the effect of church thunder against the locusts of Ethiopia. He made the Portuguese and the natives form in procession chanting psalms. He further caused them to catch a good many locusts, to whom he delivered an adjuration, which they were to impart to their companions, summoning, admonishing, and excommunicating them, with orders to leave the land of the Christians, and go to the Moors, or to the sea in three hours! In the chapter on neuroptera, we are informed of the ravages which the termites, accidentally introduced some years ago, are committing at La Rochelle, Ager, and Bordeaux. M. Quatrefages advises a fumigation with chlorine for their destruction. We could fill many pages with amusing extracts, but our readers will doubtless begin with getting the book from Mudie, and end in buying it themselves.

The Mule: a Treatise on the Breeding, Training, and Uses to which he may be put. By Harvey Riley, Superintendent of the Government Corral, Washington, O.W. (Dick and Fitzgerald, New York; Trübner, London.)—The great experience which Mr. Riley had during the American war gives much value to his remarks, which are particularly addressed to those who have to deal with the animal he describes. This book is illustrated with numerous engravings, and should be in the hands of our officers in countries where mules are employed.

THE FLORAL WORLD AND GARDEN GUIDE. Edited by Shirley Hibberd, Esq., F.R.H.S. (Groombridge.)—The July number of this excellent work commences with "Notes on the Cultivation of the Auricula," with a coloured plate of a handsome one, known as "Sir John Moore." "Show and Fancy Pelargoniums" come next; then we find "An Improved System of Strawberry Culture," and "Cultivation of the Peach and Nectarine," both valuable practical papers. "The Cultivation of Palms," "Select Stove Climbers," "New Plants," etc., fill up a very useful number.

NOTES AND MEMORANDA.

REMARKABLE LIGHTNING.—On the night of Saturday, the 11th, and of Sunday, the 12th July, thunderstorms of unusual violence passed over parts of Kent and Sussex. They were observed to great advantage in the neighbourhood of Ashurst Wood, near East Grinstead, and were accompanied by torrents of rain. Soon after 6.30 on the evening of the 12th, the lightning became very vivid, and continued, with some intermission, far into the night. Many flashes were scimitar-shaped, and brilliant forked lightning was frequently surrounded by a great blaze of diffused and tinted light. At one time, a return flash of great intensity started from the ground, and at another, the extremity of a zigzag flash was like Sirius in form and colour, dashing downwards to the earth. In one cloud a fire-ball was seen for a moment, and in another a dense line of light seemed to burst open as it neared the ground. The storm clouds came from all quarters, and from the North Downs to the Ashdown Forest range, in all directions the elemental conflict raged, so that it was often difficult, or impossible, to tell which roar and crash of thunder belonged to a particular lightning discharge. The sheet lightning was frequently pinkish, but often of an intense blue, and the flashes were at times so frequent, as to resemble the quick flapping of great wings of flame. The thunder was for the most part deep and full, giving the impression that the air-waves set in motion were of great extent. Mr. Slack, who was on the spot, has furnished the above particulars.

ANTHEROZOIDS OF MOSSES.—In "Comptes Rendus," M. M. E. Roze says, "The result of my first researches led me to express the opinion that these fecundating organs possessed a biciliated filament, making a spiral of two turns, to which adhered, but only during their movements, a mass of amylaceous granules. This spring, I have been fortunate by means of Hartnack's No. 15 immersion lens, in perceiving that these granules, instead of being immediately fixed to the ciliated spiral, are enclosed in a plasmic hyaline vesicle, soldered to a spiral by a sort of tangential adhesion, with a magnification of 1500 diameters. This vesicle is plainly seen by its spheroidal outline, and by the active molecular motion of its particles. Like the plasmic vesicles of the antherozoids of other cryptogams, it swells in water, bursts suddenly, and leaves the amylaceous granules to continue their lively molecular motion, which seems to coincide, normally, in the vesicle, with the cessation of the ciliary movements. The observations were made on polytrichum, bryum, and hypnum.

THE EGGS OF SEA FISH.—M. Sars, junr., states that it is erroneous to suppose that codfish lay their eggs at the sea bottom. They deposit them on the surface of the water, where they float during the period of their development. He likewise states that the mackerel (*Scomber scombrus*) lays its eggs at some leagues from the shore, on the surface of the water, where a great many fishes may sometimes be seen so engaged.

With the eggs of the mackerel, M. Sars has found those of six other fishes, among them the gurnard (*Trigla gurnardus*). The eggs of the mackerel, like those of the cod, have at their upper end a drop of oil, which diminishes their specific gravity, so as to enable them to float upon the surface. This drop of oil remains all through the evolution of the egg, and even after hatching it may be seen in the vitelline sac of the young fish. Young mackerel are recognizable by a sulphur-yellow spot placed behind the eye, not yet supplied with pigment.—"Archives des Sciences."

SUBSTITUTE FOR TRUFFLES.—M. Desmartis informs the French Academy that the galls of the *Lotos esculentus* have the flavour and perfume of the best Perigord truffles.

A VARIETY OF ALCYONELLA FUNGOSA.—Mr. E. Parfitt describes, in "Annals Nat. Hist.," an object which he takes for a variety of *Alcyonella fungosa*, growing in fusiform masses, on twigs dipping into a pond, about a mile from Exeter, near the South-Western Railway. The polyzoon has from forty-eight to fifty tentacles, longer than those figured by Allman: cænœcium repeatedly branched, upper branches only free; lower ones dark brown and coriaceous. The free upper portions thin and transparent, wrinkled in transverse folds, the edges of which are frequently brown. Apices of ectocyst emarginate like *A. Benedeni*, but not ridged or furrowed. Stotoblasts of three kinds:—1. Annules rather broad, centre perforated with rather large perforations, sides or edges of which are pressed into folds. These vary in colour from pale yellowish brown to full brown, and dotted with raised points. 2. Broader, nearly obicular, dark brown, and without proportion. 3. Very broad ellipse, with very broad annulus, nearly approaching form of stotoblast of *Lophopus crystallinus*, but thicker, and more opaque.

THE HIGH TEMPERATURE OF JULY.—We are indebted to James Glaisher, Esq., F.R.S., for the following details of the extreme temperature observed at Greenwich. The highest readings of a thermometer, with its bulb placed four feet above the ground, in the shade, and removed as far as possible from the reflected heat of surrounding objects, will be found in the first column, S. T. The second column, G. T., gives the readings of a dull blackened-bulb thermometer in vacuo, placed on grass, at the same times as those of the first column.

DATE.	S. T.	G. T.	Highest Shade Temperature at Wimbledon.
	°	°	°
JULY 13	82·7	158	83·5
" 14	85·7	150	84·
" 15	88·0	156	89·5
" 16	82·0	161	91·0
" 17	84·0	127	Not read
" 18	87·8	162	86·0
" 19	82·8	147	——
" 20	90·0	159	85·5
" 21	92·2	153	94·2
" 22	96·6	168	96·2
" 23	79·7	135	

The column of Wimbledon temperatures, for which we are also indebted to Mr. Glaisher, is taken from the readings of a thermometer properly placed, made under the directions of Mr. Pastorelli.

BUTTERFLIES AND MOTHS IN DISGUISE—AT REST.

INSECTS IN DISGUISE.

BY T. W. WOOD, F.Z.S.

(*With a Coloured Plate.*)

In surveying the animal creation, an intelligent observer will find a large majority of its members wearing disguises, the study of which is most interesting on account of its very close bearing upon their history. The world of insects, especially, possesses innumerable instances of it, many of which have been made known, but there is no doubt that a vast and fascinating field of discovery is yet open to reward the labours of those who will explore it industriously and with intelligent enthusiasm.

Wherever disguise is found, it can always be shown to be of vital importance to its possessor; and that portion of the surface where no disguise is needed often presents a great contrast to the rest. The common white butterflies of our gardens may be mentioned as very familiar examples; their colouring being so arranged that not a particle of the very conspicuous white can be seen when they are asleep, but only the dusky yellowish which colours the under sides of the hind wings and the tips of the fore wings. It may be further observed that this colour *alone* is seen only when the creature rests strictly speaking, and not when it merely settles on a leaf or flower on a sunny day, for the wings are then more or less open, and the white shows strongly. In this case, however, the insect is always thoroughly on the alert, and would avoid any approaching enemy by flight; in the evening, however, or on very dull days, they are fast asleep, and when found are as easy to capture as the plucking of a flower. Their disguise is also aided by their instinct; for, as evening approaches, one may frequently notice the fastidious care displayed by these insects in the selection of their resting-places, as they seem to alter their minds many times before finally settling down for the night.

The lovely little orange-tip (*Anthocharis cardamines*), so beautiful as it gaily flutters along the hedgerows on a sunny spring morning, is most wonderfully protected by the colouring of its under surface when it is resting at night on the buds or blossoms of the wild parsley (*Anthriscus sylvestris*) (see Coloured Plate), or some other small white flower; and I have never seen the insect touch the wild parsley for any purpose but sleep, as it visits the little pink geranium during sunshine for the nectar it contains, at which time

the wings are open, although not widely expanded. If the collector requires a few very fresh and uninjured specimens of this insect, he need only furnish himself with a few boxes, and walking along the hedgerows on a calm evening in May, his eyes will be gladdened by the pretty white bunches of wild parsley-blossom in great profusion, amongst which, and simulating them exactly, he will be sure either to spy or pass by the orange-tip. In the former case, all that is necessary is to open a box and close it very gently upon butterfly and flower, severing the flower stem outside the box, and placing it with its contents in his pocket. On arriving home, he will generally find that the insect has not moved in the least. Care should, however, be taken that the box is carried steadily, and that only a small piece of the blossom is inclosed, otherwise it may occupy too much room in the box, and the butterfly will be damaged in consequence. If carefully managed, the insect will not have been touched, and may now be killed without touching it, by placing the box under a tumbler with a few drops of Scheele's prussic acid on blotting paper, and in a very few moments the beautiful creature will be found lying dead and stiff at the bottom of the box; but it will be sure to relax the next day, and will then be fit for setting. This mode of capture I would recommend as being preferable in many respects to the one usually adopted with butterflies. There is no fluttering, and consequent damage, while in the net; the collector will not have to endanger his limbs by running madly over sometimes very uneven ground, with eye necessarily fixed only upon the one object of pursuit, which, when caught in the net, has to be disabled by a pinch in the thorax, intended to kill, which it never does; but the beauty and symmetry of form are often irretrievably injured by fracture of the outer skin or shell, which in all insects is their chief framework; legs are frequently broken off, and much beautiful down removed. By my plan all these drawbacks are avoided, and it has the crowning advantage of being highly instructive and entertaining. The blue butterflies may always be obtained by going to their haunts in the evening, and looking for them resting with their heads downwards on the buds and blossoms of grass, plantain, etc. (see Coloured Plate); which, with their beautifully-spotted under sides, they so closely resemble in general appearance when in this attitude that they usually escape being noticed. There can be little doubt that all butterflies have the under surfaces of their wings so coloured as to form disguises, which are perfectly calculated to concealment in their places of repose.

I have observed a remarkable peculiarity in the brimstone and clouded-yellow butterflies; namely, that when settled, although but for a moment or two, their wings are kept rigidly closed, notwithstanding the great beauty of their upper sides, which most butterflies are fond of displaying in the daytime, and exposing to the sun. These, however, are exceptions to the general rule, as the disguised under sides are exposed to view during their waking hours.

The chrysalides of butterflies possess a most astonishing means of eluding observation, their shells being photographically sensitive for a short time after the caterpillars' skins have been shed, so that each individual assumes the colour most prevalent in its immediate vicinity. This interesting fact not being generally known, I last year reared caterpillars of swallow-tail and white butterflies for the purpose of obtaining chrysalides for exhibition at a meeting of the Entomological Society; the mode of procedure was suggested by me in "Recreative Science" for July, 1860, page 35, and is simply as follows:—Caterpillars were obtained and reared on their proper food plants, and when full fed were placed in boxes, the insides of

FIG. 1.

which had been coated with colours of different kinds; as soon as they had fixed themselves, the boxes were opened and exposed to sunlight in a window. The most successful specimens of colouring in the chrysalides were obtained when the changes took place on bright days, and when the individuals were surrounded by a quantity of the same colour as that on which they were placed. Under these conditions the markings peculiar to the species were greatly overpowered when necessary to the assimilation of colour; they were, in fact, completely overpowered, and replaced by bright green in chrysalides of the swallow-tail (*Papilio machaon*) and white butterflies now in my possession. I also exhibited a great number of chrysalides of the two common species of white butterflies taken from the stone-coloured sides of a house; against one of the sides

a grape vine was trained, and here the chrysalides of both species were green, being affected by the light shining through the leaves; on the bare side of the house not a single green specimen could be found, and a glance at them conveys an accurate idea of the colour of the surface to which they were attached. As caterpillars are evidently unaffected by colour in their choice of a resting place on which to undergo their transformations, it follows that this photographic power in the chrysalides is most important, as tending greatly to make them invisible during their period of exposure in a condition of utter helplessness, which consists of from a few weeks to half a year, and in some exceptional cases of more than a year. The gilded chrysalides of Vanessidæ and other genera are extremely beautiful, and my opinion of their gilding being a protection against birds, has been confirmed by Mr. Jenner Weir, who says that birds will not touch them, evidently mistaking these chrysalides for pieces of metal. I have noticed particularly that the chrysalis of the small tortoiseshell (*Vanessa urticæ*) is golden only when found amongst nettles, for when on walls, palings, tree trunks, etc., it invariably partakes of their colours and general appearance of surface. The same remark may be made with regard to the chrysalis of the large tortoiseshell (*Vanessa polychloros*), which, when found amongst leaves, is of the colour of a withered elm leaf, with a few silver spots; when, however, on walls, etc., the whole colouring is different, and the silver spots are absent. Now it would be no advantage to these chrysalides to assume the *green* colour of the leaves, for they hang quite loosely by the tail, with no band of silk to keep them close to their surface of attachment, and the green colour would only make them look like tempting morsels to birds, etc. It is, however, very remarkable, that chrysalides belonging to this genus, are affected by green leaves so differently from those of the genera Papilio, and Pieris. The chrysalis of the orange-tip, so remarkably lengthened in form, appears to resemble the seed-pod of a cruciferous plant, that of *Papilio podalirius* is coloured, ribbed, and veined like a dead leaf. See Fig. 1, *a*, *b*, and *e*.

Let me now call the reader's attention to a few instances of disguise in caterpillars. A most beautiful example of it is found in that of the swallow-tail butterfly, which feeds on carrot-leaves. Amongst the carrot-tops, of which I obtained a quantity last year, to feed these creatures, my eye was momentarily caught by a small leaflet which was in strong relief against a dark background; for a moment I thought it was one of these caterpillars, but a closer view quickly undeceived me. This trifling incident led me to compare the cater-

pillar and the leaflet as viewed with a very dark background behind it, and I soon discovered that the black markings of the insect as

Fig. 2.

viewed from the side, imitate to a nicety the interstices between the smaller serrated leaflets; the diagonal terminations of the stripes on each side are most wonderful aids to the resemblance, and even the orange spots are found to be placed exactly where that colour commences to appear on the carrot-leaf, namely, at the points of the serrations: in size, also, the insect and its markings agree exactly with the leaves. The caterpillars of some Geometridæ, so marvellously like dead twigs, both in appearance and inactivity, during the daytime, have their disguise carried further than might be expected, for, where the creature is in contact with the branch on which it rests, that is, between the claspers, there is seen a very light space of greenish white of exactly the same colour as a twig at the part where it has been freshly broken from the tree! The caterpillar of the red underwing moth *(Cotacala nupta)*, is so formed and coloured, as exactly to imitate the willow bark on which it rests during the day, stretched at full length; the body is much flattened underneath throughout its whole length, so as to fit closely on to the bark; the head slopes obliquely, so as not to attract attention by its being at right angles with the surface on which it is placed, and

along each side, just above the legs, there is a fringe of filaments, the use of which is undoubtedly to catch the light, thereby preventing the form of the caterpillar from being marked out by the shadow under it; these filaments touch the bark at their ends, and form a sort of curtain. This provision for the concealment of shadow is probably possessed by a great many other insects, and should be looked for. Another very evident case in point is the abnormal young of the aphis of the maple, whose body, head, and legs are fringed with flat leaflike appendages so placed as to form, when the creature rests on the surface of a leaf, and contracts its legs, and antennæ, a continuous fringe all round its body, thus preventing its form from being marked out by shadow, and in conjunction with its green colour rendering it almost perfectly undistinguishable from the surface of the leaf on which it reposes. One more instance of special adaptation may now be mentioned. The caterpillars of the Sphingidæ, although green in their general colours, when feeding amongst the leaves of their food plants, turn brown just previously to their descent to the ground for the purpose of searching for a hiding place, this colour being deepest on the back where it is most exposed to view.

There is, perhaps, nothing in the whole of the animal creation more weird-like and peculiar than that strange semblance of a skeleton which the death's-head moth (*Acherontia atropos*) carries on its velvety back. Having one year obtained more than a dozen chrysalides from one potatoe-field, I had an excellent opportunity of studying this very great curiosity while alive; and I feel convinced now, as I did at the time, that it is disguised in a most extraordinary manner. When at rest, it sits with closed wings, and is then a very dark-looking object; but, on being disturbed, it immediately becomes greatly agitated, fluttering about and separating its fore-wings, the abdomen, with its rib-like bands, being exposed to view; and, in connection with the skull-like marking on the thorax, forms a figure not unlike the upper part of a skeleton, so that when you touch this moth you are immediately threatened with death, and the threat is accompanied by a sort of grating squeak. Now it is easy to perceive that these remarkable peculiarities would, in the long run tend very greatly to the preservation of the species; it has a very widely extended range, and a convincing proof of its power is found in the fact that it possesses a mimic, which copies *Acherontia lethe* (a very near ally of our own death's-head) in a most remarkable manner. This moth is *Macrosila solani*. Mr. Roland Trimen, of Cape Town, called my attention to this very

interesting circumstance. However, as the mimic and its original both belong to the same family, the tyro might be misled into thinking that the extraordinary resemblance between these two insects, in colour and markings, was indicative of very close relationship. So far is this from being the case, that, in the great collection in the private room of the British Museum, they are separated by five genera, which contain no less than forty-four species. It would be a matter of curious interest to inquire as to whether the skeleton-like disguise of the death's-head moth is of use to it solely as a protection against man; and, when we remember that it is found in China, India, and Africa, which include the most ancient and densely-peopled countries known, and when we also bear in mind that the insect is connected with man in two other important particulars—namely, the caterpillar feeding on potatoe-leaves, and the moth robbing bee-hives of honey—I think there is at least a possibility of such being the case; especially if the attitude of the moth, when disturbed, be considered. The hornet clearwing (*Sphecia bembeciformis*), so waspy in appearance, and unlike what it really is—a moth, on being interfered with, pretends to sting by repeated thrusts of its yellow-banded abdomen, thereby carrying out to the fullest extent its harmful appearance, although it possesses no weapons, but relies entirely on its disguise for protection, which, however, is so complete, that only entomologists would ever think of its being a moth. The privet hawk-moth (*Sphinx ligustri*) will also assume a threatening attitude when disturbed, as if it could and would sting; but it does not persevere in this in such a marked manner as the hornet-moth.

The angle-shades moth (*Phlogophora meticulosa*) is well worthy of a passing notice, from its peculiar and probably unique appearance during the day, its time of resting, the fore-wings being curled on their outer margins, thus adding greatly to the disguise, which is evidently that of a withered, dried-up leaf (see Coloured Plate). The curl disappears immediately on the moth's preparing for flight, for the wings are then seen to be as flat as those of any other insect. The lappet moth (*Gastropacha quercifolia*) presents another very beautiful picture of a dead leaf, the palpi projecting very much in front of the head to form the stalk; and the buff-tip moth (*Pygæra bucephala*) looks exactly like a piece of stick, the colour, marking, and attitude being an exact imitation. There is also a small moth, very common in gardens, which I cannot refrain from mentioning here; it belongs to the genus Antithesia, and is remarkable as appearing, when at rest, exactly like the excrement of a

sparrow, or other small bird, and, as we always find, its habits suit the disguise it wears, for the insect sits fully exposed to view on the upper surfaces of leaves, etc., and I have seen it drop off when the leaves were shaken, as if it were really a lifeless object (see Coloured Plate).

I remember once finding the buff arches moth (*Thyatira derasa*) at rest on the stem of a currant-bush, and think it was in or near the fork of two branches; it was low down, certainly not more than one foot from the ground. What particularly took my attention was its resemblance to a small fractured flint stone, which I at first took it to be. The fore-wings were placed together in the form of a high roof, so that only one of them could be seen at a view, and this gave a very compact, solid appearance. There is a patch of colour at the base of the fore-wings, exactly of the same tint as we find in the fractured or inside part of a small flinty pebble, edged with white as in the stone, outside of which is seen an irregular pattern composed of rich rufous brown, this being the exact colour of the gravel-dust on the outsides of these stones.

By studying the upper side of a moth, or the under side of a butterfly, a pretty accurate idea may often be formed of its attitude during repose, and also of its resting-place. Who can doubt that the marvellous dead-leaf butterfly of Northern India (*Kallima inachis*) sits in a position to show almost the *whole* under surface of both wings? There is a strong dark line representing the midrib of a leaf which runs across both wings, and would be broken into two separate parts, each taking different directions, were the insect to sit in any other attitude. The large tortoise-shell and peacock butterflies (*Vanessa polychloros* and *io*) show the greater portion of their under surfaces when asleep; but the small tortoise-shell, red admiral (*Vanessa urticæ* and *atalanta*), and the majority of the British species show the hind-wings, and only the tips of the fore-wings.

Perhaps the most wonderful fact in relation to the present subject, is that in many of the disguises the background is imitated. The caterpillar of the swallow-tail butterfly is a case in point; also the orange-tip butterfly, the white of whose hind wings on the under side is cut up by a dusky, dark green into a great many small irregular pieces of exactly the size and general appearance of the little white flowers upon which it rests, as seen relieved against a dark greenish background. There are some very fine species of charaxes butterflies in India and China, which have their under surfaces of a very beautiful bluish white, crossed by a few thin bands

of brown. Now these insects are very high fliers, and frequent high trees, and there is little doubt but that they rest high up amongst the branches. I therefore think it extremely probable that their very light ground colour represents the sky, and the brown stripes the branches amongst which they in all probability repose; and this is not at all an extravagant notion, as an instance of a dark background being represented on the wing of a butterfly has been clearly proved; therefore why not a light one? The white colour in the butterflies mentioned is slightly tinged with a greenish blue, and has a glistening, polished surface, which would reflect the sky colour from all quarters, and the brown markings offer a strong contrast in being non-reflective; therefore they would be seen far more easily than the other portion of the surface, and being greatly like the surrounding branches, would not attract the eyes of an enemy; consequently the creature's life would be preserved in accordance with the well-known Darwinian hypothesis of the survival of the fittest. Our own large tortoise-shell, red admiral, and some other butterflies, retire to rest on the trunks of trees just underneath the bases of the branches, or on the under parts of the branches. The obscure appearance of these insects when at rest, need not be dwelt upon here, but it may be pointed out how well adapted for their protection against wind and rain is the part of the tree which they select. When these very handsome insects are sitting upon the ground, with wings widely extended to catch the sunbeams, they sometimes close them with an exceedingly sudden movement on any person's approach, instead of flying; thereby often effecting a disappearance without leaving the spot.

My friend, Mr. A. G. Butler, of the British Museum, has informed me of a singular habit peculiar to the clouded-yellow butterfly, which must be of very great use in aiding its escape from pursuing enemies, it may be stated as follows:—The time when this insect is to be found in the greatest profusion is towards the end of August, when the fields of corn are being cut, and as corn and clover (its favourite plant) are almost always grown in neighbouring fields, the clouded-yellow, when hotly pursued, invariably makes for the stubble over which it is utterly impossible to follow it, its colour being exactly the same. Mr. Butler has also noticed its trick of suddenly closing the wings, and dropping to the earth when chased, but he has only observed this upon sultry days, when there was no wind to assist its escape by flight.

Amongst the moths, those of the Sphingidæ belonging to the genus Smerinthus, are remarkable on account of the very peculiar

attitude assumed by them during the day, the wings being partially raised and much separated from the body. For a description of this peculiarity, with illustrations of the eyed-hawk moth (*S. ocellatus*), the reader is referred to the article in "Recreative Science," before mentioned. Moths belonging to the genus Chærocampa, are somewhat similar in this respect but more elegant; indeed, they are probably the most elegantly formed of all nocturnal insects, besides possessing charming colours and markings.

There are many examples of lepidopterous insects having showy colours on those parts of their wings which must be exposed to view when they are at rest. Some exotic Pieridæ have the most conspicuous reds and yellows so placed; but it is probable that, as with our orange-tip, there are flowers in bloom at the times of their appearance of suitable colours to match their own, and on which they can repose in safety.

The very numerous species of swallow-tail butterflies are remarkable as having their most beautiful colours confined to their hind wings on both surfaces; the English species may be taken as a good type of the family in this respect, the general colour being a pale yellow with black markings; added to which, on the hind wings only, we find blue minutely dotted on black, and a rich red ocellus surmounted by blue. On examining the very extensive collection of swallow-tails in the British Museum, I counted one hundred and thirty species possessing this character, and only about thirty exceptions, omitting to count the species in twenty drawers where there were no exceptions to this rule. There is another group of butterflies, the Catagrammas of South America, whose under surfaces are in most of the species conspicuously coloured, and all have a strongly marked character well known to entomologists: now of the habits of both the above-mentioned groups comparatively little is known; this is much to be regretted, and it is to be hoped that more attention will be given to this most interesting branch of entomology. Collectors should certainly watch insects to their resting-places, as they would find it conduce greatly to the filling of their boxes.

There are a few cases which may be considered exceptions to the law of disguise during repose. The currant-bush moth (*Abraxas grossulariata*), so very common in gardens, is very showy, although it generally hides itself, but it must be admitted that in this it is not always successful; this, however, is compensated for in two ways at least; firstly, by its being far more wakeful than many other moths; and, secondly, by its wonderful propensity of feigning death

when captured, in which, by the way, it is not at all singular. There is also another smaller moth belonging to this family, commonly found in gardens in the south of England, this is the yellow shell (*Camptogramma bilineata*), and an extremely pretty, lively insect, but it is very careful in concealing itself under the friendly shelter of a leaf during the daytime. The burnet moths (*Anthrocera*), are very conspicuous and somewhat sluggish, and it is rather difficult to account for their numbers, unless by supposing that they possess a flavour which is distasteful to birds. I have often been puzzled to know what becomes of the hundreds of marbled-white butterflies (*Arye galathea*), seen in certain localities, which seem as if all swept away at eventide only to reappear as lively and beautiful as ever the next morning, but Mr. J. B. Waters, who is an intelligent observer, and has collected insects very extensively, has found them at night close to the ground, near the roots of long coarse grass, and this fully accounts for their disappearance.

Some of the patches of colour on insects' wings have exactly the appearance of deep shadows as they would be painted by an artist, and they must very frequently prevent the real form of the creature from catching the eye. Instances of this are very numerous; the eyed-hawk moth is one, and I recollect to have noticed it in a beautiful hawk moth (*Philampelus achemon*), the chrysalis of which I was fortunate enough to obtain, with others, from North America. The leaf disguises are, however, the most apparent to all; one of a very beautiful description is possessed by a large white, red-tipped butterfly in India (*Iphias glancippe*); this, as also the marvellous stick insects have been described by Mr. A. R. Wallace, as seen by him in their wild state, for which the reader is referred to an article in "Science Gossip," for September, 1867.

It is interesting to notice how exactly the two halves of insects correspond both in form and pattern; the scolloping of the edges of the wings of the Vanessidæ agree to a nicety when placed together by the butterflies, although they are not in contact when in the chrysalis shell, but are developed on the two opposite sides. There is, however, a certain class of markings in which this rule is violated; I refer to the smaller mottlings on the wings, particularly the minute transverse striæ which on examination are generally, perhaps always, found to be what is called unsymmetrical. The wood leopard moth (*Zeuzera æsculi*) is a very striking example of unsymmetrical markings, as it always has the spots differently arranged on its opposite corresponding sides. The currant-bush moth is another example, although not quite so evident, and the mottlings on the under sur-

face of the orange-tip's hind wings are unsymmetrical in their details. Indeed, this character in the markings is very generally found on the disguised portions.

In conclusion, I would beg to call attention to the great advantages which would be gained by the establishment of insect vivaria, at least as regards the enjoyment of admiring and studying the exquisite works of the creation, and it would be of great service to science as the species of whose early history nothing is known are innumerable. Exotic plants are reared in great numbers in this country, and we therefore possess food already for the purpose of feeding the caterpillars of a great many species, which are often as beautiful as the imagos, sometimes much more so. Still the fully-developed insects are the crowning glories that all must admire more or less; and although I yield to none in my admiration of flowers, I think they are equalled, and often surpassed, in beauty by their animated rivals.

(Coloured Plate fully explained and referred to in the text.)

EXPLANATION OF CUTS.

Fig. 1. *a*, *b*, chrysalides of orange-tip butterfly (*Anthocharis cardamines*) attached to seed-pods; *c*, chrysalis of large white butterfly (*Pieris brassicæ*) taken from a tarred fence; *d*, chrysalis of the same taken from a white surface; *e*, chrysalis of *Papilio podalirius* attached to a dead leaf.

Fig. 2. Caterpillars of swallow-tail butterfly (*Papilio machaon*) on carrot leaves.

VARIATION OF STRUCTURE IN CRUSTACEAN ANIMALS.

BY JONATHAN COUCH, F.L.S., C.M.Z.S., ETC.

Of all the classes of animals with which I am acquainted, there are none so frequently found subject to abnormal structure as the stalk-eyed Crustaceans, or those which include the crab and lobster tribes, of which, however, I have only had the opportunity of examining those species which are met with in the sea that flows round the British Islands; and chiefly such as are the object of the attention of fishermen. There can be little doubt, however, that the kinds which inhabit more distant regions are liable to similar malformations, the laws that influence which are worthy of the attention of naturalists.

And in considering this subject there appears in the first place to be a rule of very extensive if not universal application, which is, that the variation of structure shall be limited to the addition of organs, either in whole or in part; and thus it is exceedingly rare for a positive deficiency to be met with, although I have met with such an instance. Nor does it appear to be an objection to the generality of this remark, that in an example of a small species of the genus Pisa—one of the so-called spider crabs—the usually projecting snout was absent, for it was the opinion of an eminent naturalist that this deficiency had been produced by some violence that had been inflicted, perhaps in the course of its growth, the wound of which on the soft part within had been healed, so that the shell or crust had afterwards become accommodated to the substance within. The snout or proboscis of the prawn (*Palæmon serratus*) is also subject to variation as regards the direction of the serrations; but in one instance I have observed such a contraction of its extent as might even suggest the thought that the individual may have been of a distinct species, which in my opinion was not the case.

In every instance that has come under my inspection, except in two examples presently to be mentioned, and one of which is highly remarkable, an acknowledged rule of nature as governing the development of structure in all living animals has been manifest; which is, that in the formation of abnormal structures by addition, a similar part, whether whole or imperfect, shall constitute the addition to the primary organization; so that if the addition be to the head, a head is added, either whole or in part, and a tail to the tail; of which examples have been produced, as regards fishes and a serpent, in a former number of this work; and a body is also recorded as having been added to the original body. It is, indeed, exceedingly rare for an abnormal organ or a portion of one to be found in the place of another which does not bear a close analogy to that to which it is an addition. Yet there are instances of a variation of this rule, which have been recorded even in the higher class of animals; as an explanation of which it might be supposed that a double embryo had existed in one ovum, and of which some portion had ceased to advance in development or had vanished, while those portions which retained their organic life had become amalgamated with a locally contiguous portion of the more perfect embryo. Whether among crustacean animals, which only at this time it is my purpose to consider, any one organ shall become multiplied after birth may be a matter of doubt; but whilst this may at first sight be scarcely considered improbable, when we consider

that all the genera of this large family are possessed of a power to supply the place of some of their external organs when they have thrown them off or lost them, and also that the size and appearance of the renewed organ will vary greatly in the course of its development. Yet beyond doubt there are well defined bounds to these renewals and mutations; for as regards the situation, a renewed limb is not replaced indiscriminately, but at a part or joint specially organized for that purpose. It is also known as a general practice, that one organ is not substituted for another in the renewal, or after the creature has obtained its normal structure. Perhaps the most remarkable on record of an anomalous organization was that of an example of the sand-shrimp (*Crangon vulgaris*), which was exhibited at the meeting at Plymouth of the British Association, in the year 1841, and which must have received its shape and structure from a doubling of forms in the ovum. The front and carapace were at the opposite ends, and on the upper portion, the union of these apparently separate bodies was at the posterior border of the carapace of each. One of these carapaces was less perfect than the other, and on the under surface, the form of the annular portion was continued from the opposite carapace up nearly to the mouth, so that these apparently united bodies were not constituted of exactly two halves, but the shape or portion of one was continued under the upper portion of the other, thereby rendering it so far defective in its requisite proportions. There were not any perfect circular rings of the body, and on neither of them was there any appearance of a tail or caudal plates; nor could there be discerned any mark of a vent, although it is to be supposed that such an orifice existed, for this individual had attained the full size of its species. It was caught in the harbour of Plymouth, and the officer of the Royal Navy who had the care of this example was acquainted with the particulars of the capture.

The pincer claws of the common edible crab (*Platycarcinus pagurus*), are as different from the legs, both in use and structure, as the hands of a man compared with his feet; and yet an instance has fallen under my notice where, in addition to the regular number of these handclaws, another had taken the place of the second of the ordinary legs on the right side; and although somewhat less in size, it appeared equally capable of grasping an object as its more legitimate fellows at the front. In fact the knobs which armed the fingers were even larger than those of the others.

In an example of the common edible crab, the grasping portion of the claw was so curiously formed, that in place of a lengthened

description that might be unsatisfactory, it will be best represented by a figure, 1. Another had a blind prominence jutting out at the side, Fig. 2; and a third had the moveable finger developed

FIG. 1.
Claw of the Common Crab.

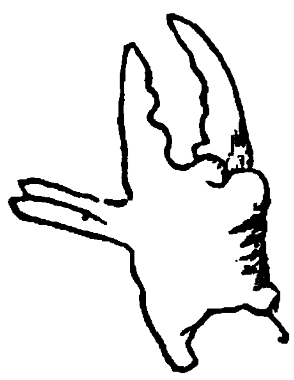


FIG. 2.
Claw of the Common Crab.

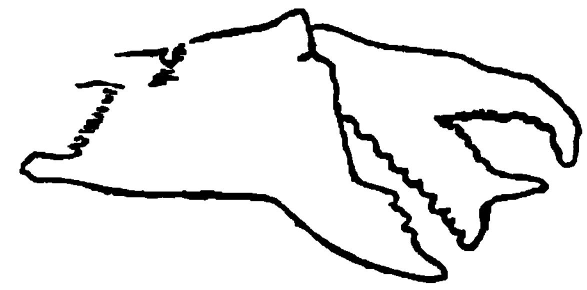


FIG. 3.
Claw of the Common Crab.

into three prominences, Fig. 3. An abnormal formation of the handclaw of the Corwich crab (*Maia squinado*) is represented, Fig. 4, and again Fig. 5; and another instance of the multiplication of

FIG. 4.
Irregular Claw of the Corwich Crab.

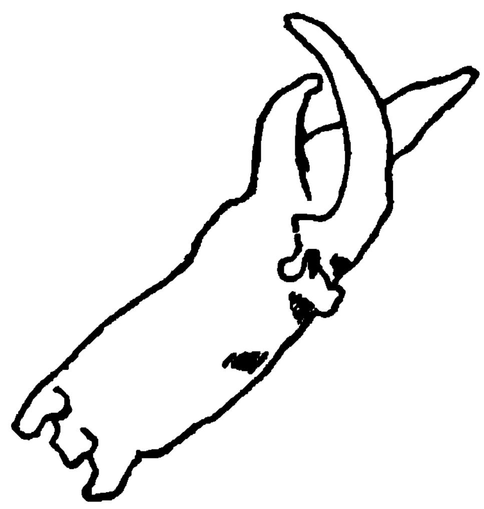


FIG. 5.
Claw of the Corwich Crab.

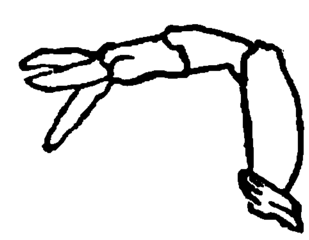


FIG. 6.
Leg of the Common Crab.

parts, where three distinct and apparently well-formed portions of a limb take the place of one, in the leg of a common crab, is seen at Fig. 6. In what manner, with these complications, these coverings could be thrown off in the process of exuviation it is not easy to imagine; as also in the following instance—where on one peduncle of the antennæ there were three of these organs, each one of which was of the usual size, but one was distorted or twisted in its course. At their root they did not stand on one level, one being below; but the two others sprung from the peduncle together, at which point they were divided by three stout spines, which were placed triangularly

A variation of colour is not less conspicuous than an abnormal variation of organization, although perhaps less frequent; but that it has been noticed chiefly in the lobster may proceed from the circumstance that the colour is more decided in that species of Crustacean than in any other. Instead of a deep blue as is usual, it has been found alive of a bright red; which is the colour to which the surface changes when subjected to the action of boiling water; and in another instance the body and limbs were of a cream colour,

nearly white, which is to be explained by the want of development of the peculiar tint on which the usual colour depends, and which is curiously shown in a partial manner in the instance described by Frank Buckland, Esq., in "Land and Water," the particulars of which have come to my knowledge since the former portion of my remarks on this subject was written. "One half of the head portion is the natural blue, the other half is a cream colour, and the line of demarcation between the two is as distinctly marked down the middle of the back as if it had been ruled with a pencil. It even extends along the little horn-like process over the lobster's eyes, and one side of this projection is white, the other the usual colour. The horn on the white side is quite stunted, and much resembles a large wheat corn. The horn on the opposite side is quite natural. I fancied at first that the peculiarity of the white shell was caused by its being newly formed, but upon opening the lobster I find under the shell the thick membrane which represents the new shell in process of formation when the old one is ready to be cast off. In order to make a rough test of this phenomenon I cut out a piece from the blue side, and also a piece from the white side of the lobster, and boiled them both; the portion from the blue side of course turned red at once, but that from the white side remained white. The middle lobe of the tail of the lobster was also white, all the rest of the shell was of the natural colour. I placed this lobster's shell in spirits of wine, and on looking at it in about six hours' time I was astonished to find that the spirits of wine had turned the blue side into a bright red, just as though the lobster had been boiled, the white side, however, remains quite unaltered." In reference to the line of demarcation along the carapace, mentioned above, it should be remembered that it is the part which becomes separated when the creature is about to quit its covering in the process of exuviation. The lobster is the only one of this family in Britain that exuviates in this manner; and it may be supposed that in order to adapt the shell to this process, the circulating vessels that prepare the colouring matter are not carried across the line as they are in other species where no such process of separation takes place. In other long-tailed stalk-eyed Crustaceans, the escape of the animal in the process of exuviation is where the rings are united to the carapace.

I have also met with a remarkable variation of colour from the ordinary tints, in the crawfish, *Palinurus vulgaris*. The example was of full growth, and the carapace of the ordinary dark-red colour, but the rings of the body and tailplates were of a yellowish cream-

colour, as were also the hand-claws and legs—except a patch on the fourth ring, which was of the colour of the carapace. The plate also of the tail, on the left side, had a tint of reddish brown. The hindmost legs were especially pale; and the last of them on both sides, had its finger double; so that instead of a single pointed moveable finger, there were two projections of full size, united at the base. It was a female, and a few grains of red ova remained unshed, amidst a quantity of very small and pale ones that seemed rudimentary.

WOMANKIND:

IN ALL AGES OF WESTERN EUROPE.

BY THOMAS WRIGHT, F.S.A.

CHAPTER V.

TRANSITION TO THE FEUDAL PERIOD; WOMANKIND IN THE CASTLE; THE ANGLO-NORMANS.

During the long period of which we have been treating in our last chapter, a great revolution had taken place in the condition, social and political, of the dominions of the Franks. The dynasty of the Merovings, by its own discordant character and weakness, had fallen, and given way to a new race of kings. Charlemagne gave to the royalty of the Franks a new character; he possessed in a high degree the Roman spirit, and for a while he brought back into existence the Roman empire, with all its powerful centralization. But Charlemagne's influence and power of government belonged to himself, and disappeared after his death, and his death was followed very quickly by utter disorganization throughout his vast dominions. Under the terrible invasions of the Northmen, which soon followed, not only all central power, but in some sort all power whatever disappeared.

Out of this great and painful confusion arose an entirely new state of society, which we know as the *feudal system*. It was a state of things to which the old society had been gradually converging, but its immediate cause must be sought in the fearful state of desolation and anarchy which followed the invasions and ravages of the Northmen. All central power, that of the monarchic institutions, had become paralysed, and the great chieftains, with their vast territories, had by the existing system no armed force to defend

them. Under these circumstances they introduced a new method of distributing their lands, which was by granting it hereditarily on the conditions that the tenant was bound not only to cultivate the portion of land he held, but that he should perform certain military services according to its extent; or, in other words, that he should lead to the standard of his superior lord in time of war so many armed men for so many acres. This new sort of grant was called in medieval Latin *feudum* or *feodum*, and sometimes *feofum*, from which latter form it derives its more modern name of a *fief*. As this plan was found to answer its purpose sufficiently well, the whole landed property of France passed in the course of the tenth century into this sort of tenure, which, from the word just mentioned, was termed *feudal*. It brought with it new institutions and new forms of life. Under this new system, the landed aristocracy assumed and exercised, each within his own domains, sovereign power, both legislative, judicial, and military, and the state was transformed into a number of little sovereignties. The new lords of the land formed alliances among themselves, or made war upon each other, at their own will, and their whole aim was to keep themselves in a permament state of defence. The old residences, which had consisted of a confused mass of buildings, with little or no capability of defence, inhabited in great part by men attached to the cultivation of the land, by artizans of various kinds, and by slaves, were now abandoned, and their places were supplied by almost impregnable fortresses. The castle, indeed, is become, in a manner, the symbol or image of feudalism. In this fortress, placed at a distance from all social life without, the lord and his family lived in a complete state of isolation. Without occupation in this solitary abode, life at home must have been so wearisome that the great desire of the male part of the household must have been to be absent from it; and hence we find the possessors of fiefs passing their time on the high road, in adventures of every kind, courses, wars, plunderings, anything which promised violent activity. The coarseness and ferocity which arose out of this life threw a new impediment in the way of social and intellectual improvement, and these early ages of feudalism were, indeed, ages of darkness. Yet, as one of the ablest of our modern historians has observed, "at the same time that castles opposed so strong a barrier to civilization, while it had so much difficulty in penetrating into them, they were in a certain respect a principle of civilization; they protected the development of sentiments and manners which have acted a powerful and salutary part in modern society; every-

body knows that domestic life, the spirit of family, and particularly the condition of woman, are developed in modern Europe much more completely, and with more happiness, than anywhere else. Among the causes which have contributed to this development, we must reckon life in the castle, the situation of the possessor of the fief in his domains, as one of the principal. Never, in any other form of society, has a family reduced to its most simple expression, husband, wife, and children, been found so closely drawn together, pressed one against the other, separated from all other powerful and rival relations. In the different states of society of previous periods, the head of the family had, without absenting himself, a multitude of occupations and diversions which drew him from the interior of his dwelling, and at least hindered it from being the centre of his life. The contrary happened in feudal society. As often as he remained in his castle, the feudal possessor lived there with his wife and children, almost his only equals, his only intimate and permanent companions. Without doubt, he often left it, and led abroad the brutal and adventurous life just described; but he was obliged to return to his home, where he shut himself up in times of danger. Now, whenever man is placed in a certain position, the part of his moral nature which corresponds to that position is favourably developed in him. Is he obliged to live habitually in the bosom of his family, with his wife and children, the ideas and sentiments in harmony with this fact cannot fail to obtain a great empire over him. So it happened in feudal society. When, moreover, the feudal possessor left his castle to go in search of war and adventures, his wife remained there, and in a situation very different from that which women almost always held in previous times. She remained there as mistress, or lady, of the castle, as representative of her husband, charged in his absence with the defence and honour of the fief. This situation of rank, and almost of sovereignty, in the very bosom of domestic life, often gave to women of the feudal epoch a dignity, courage, virtues, and a splendour which they had not displayed under other circumstances, and contributed powerfully, no doubt, to their moral development, and to the general progress of their condition. This is not all. The importance of the children, of the eldest son among the others, was greater in the feudal household than anywhere else. There was displayed not only natural affection, and the desire of transmitting his goods to his children, but also the desire of transmitting to them that power, that superior situation, that sovereignty inherent to the domain. The eldest son of the lord was, in the eyes of his father and of all

his followers, a prince, a presumptive heir, the depository of the glory of a dynasty. Thus, the weaknesses as well as the good sentiments, domestic pride as well as affection, joined in giving to the spirit of family much energy and power. Add to that the empire of Christian ideas, to which I only here point passingly, and you will easily understand how this castle life, this solitary, sombre, and hard position, was nevertheless favourable to the development of domestic life, and to that elevation of the condition of woman, which holds so great a place in the history of our civilization. This great and salutary revolution took place between the ninth and twelfth centuries. We cannot follow it step by step; we can only trace very imperfectly the particular facts which assisted its progress, for the want of documents. But that in the eleventh century it was about completed, that the condition of woman had changed, that the spirit of family, domestic life, and the ideas and sentiments which belonged to it, had acquired a development and empire previously unknown, is a general fact which it is impossible to overlook." *

Thus has Guizot told well and concisely the change which had taken place in the character of society in Western Europe (on the continent), between the ninth century and the eleventh. Unfortunately, the records of this period are very barren of materials which would enable us to form any more detailed picture of the state of society, and especially of the position of Womankind at this time. The little information we obtain shows the Frankish women of that time violent, cruel, and rapacious, while they have evidently obtained a greater degree of independence and power. This they owed, no doubt, in a great degree to the clergy, who laboured always to break down the old authority of fathers and husbands. The power of the Church had been fully established under the influence of Charlemagne, and the clergy interfered in everything, and especially in the questions of marriage, repudiation, and divorce. Although the Franks had lost the greater part of their old Teutonic sentiments and traditions under Charlemagne's empire, yet they still seemed to submit to this interference of the Church with reluctance, and often, when they had the power, they resisted it. Frequently the matrimonial relations of kings and great chieftains were, in the eye of the Church, remarkably scandalous, and the history of them throw a rather singular light on the character of the Frankish women. Thus, King Robert of France, the second Frankish monarch of that name,

* Guizot, "Histoire de la Civilisation en France," tom. iii., pp. 343—346.

married, in 997, Bertha, daughter of the King of Burgundy, and widow of Eudes, Count of Chartres. It was a marriage of affection, but the lady was his cousin in the fourth degree, which was within the forbidden limits of consanguinity, and, which was still worse in the eyes of the Church, Robert had been godfather to one of her children by her first husband, and had thus contracted what the Church considered to be a spiritual relationship far more important than any earthly consanguinity. The Archbishop of Tours, with the agreement of others of the leading French prelates, had granted a dispensation for the marriage, and given the nuptial blessing; but the Pope, who was at this time hostile to the Gallic Church, and was glad of an opportunity of showing it, declared the marriage to be incestuous and illegal, and dissolved it. King Robert, who loved his wife affectionately, although in character pious and gentle to weakness, refused to submit, and resisted for some years, under what were then the dreadful effects of a Papal excommunication. But at length, under the threat of placing his whole kingdom under an interdict, he yielded, and separated himself from the object of his affections. Robert remained three or four years unmarried, and then took for his queen, Constance, the daughter of the Count of Toulouse, a lady of great beauty, although his first marriage had not been annulled. With Constance, the vain and fantastic fashions of the south were brought into France; but it is rather curious that at this time vanity in dress was characteristic of the male sex, and not of the ladies. The gentlemen of the period, who adopted these new fashions, were affected in their manners, and are accused by the contemporary, or almost contemporary chroniclers, of being "immodest" in their dress. Not only were their arms and the caparison of their harness extremely fantastic in appearance, but, in their own persons, they cut their hair short, shaved their beards "like stage performers," wore coats so short, that they descended only to the knees, and were slit before and behind, with small tight shoes terminating in a beak turned up —in fact, to use the words of the monastic censurer, they wore "the livery of the demon." It is again to be remarked that it was the male sex who offended pious feeling and good taste by the extravagant vanity of their dress, while the ladies are not mentioned. The chroniclers tell strange stories of the manner in which Queen Constance tyrannized over her husband. Once, during her absence on a visit to Aquitaine, Robert's favourite minister, Hugues of Beauvais, urged the king to shake off his domestic yoke, and return to his first wife Bertha. The queen heard of this, and obtained from her uncle six knights who were capable of any atrocity, and

by her orders they murdered Hugues in the king's presence, while he was out hunting. At a later period, a priest named Stephen, who had been the queen's confessor, was condemned, with others, for heresy, and burnt at Orleans. It was at this time the fashion among the ladies, borrowed from the other sex, to carry in the hand a stick with a chased head. Constance, who had placed herself in the church porch to see the heretics pass, walked up to her old confessor, and thrust out his eye with the head of her stick, which was in the form of a bird's head.

Another instance of the loose ideas of the age in regard to marriage is furnished by the history of King Philippe I. Philippe already possessed a queen named Bertha, to whom he had been married in 1071; when, during a visit to Tours in 1092, he fell in love with the beautiful Bertrade, Countess of Anjou, who was persuaded to desert her own husband in order to marry the king, and he put Queen Bertha away. A bishop was with some difficulty found, who performed the ceremony of marriage; and Ivo, Bishop of Chartres, who opposed it, was seized and thrown into prison. Upon this the Pope, Urban II., interfered, and threatened the king with excommunication, unless he put away Bertrade, and set the bishop at liberty; but he refused to desert his adulterous wife. Two years after the marriage, Urban delivered the sentence of excommunication, which, however, was not very rigidly enforced, and Philippe continued to hold Bertrade as his wife. Philippe had a son named Louis, destined to be his successor on the throne, who, on that account, was an object of hatred to Queen Bertrade, and she made several attempts on his life, in order to clear the way to the throne for one of her own sons. On one occasion she employed poisoners against him, and he escaped with great difficulty from the effects of their drugs. Bertrade herself had been the third wife of the Count of Anjou, all the three being alive. Such are the examples of Frankish Womankind, in the third dynasty, as furnished by the chroniclers.

It has just been remarked that, during these earlier ages of feudalism, the men, not the women, incur blame for the vanity and extravagance in their manners and costume. The costume of the Frankish ladies seems not to have undergone any change until late in the eleventh century; but our materials for the social history of this period are very few.* The dress of a Frankish matron of this

* M. Louandre, in his fine work, "Les Arts Somptuaires," has made great confusion in the history of this latter period, through taking his chief authority, John de Garlande, for a writer of the eleventh century, instead of the thirteenth.

period consisted of three principal pieces:—First, a close-fitting robe, with sleeves buttoned at the wrist; over this a second and wider robe; and over these a mantle, which descended behind nearly to the feet. A *guimple* (wimple), or stomacher, surrounded the neck, and covered the upper part of the breast. To the head-dress was attached a rather short veil, which formed a great pad over each ear. This description will be better understood by the accompanying cut, which represents Adelaide of Vermandois, Countess of Anjou, who died at the beginning of the eleventh century. It is taken from the effigy on her tomb, formerly in the church of St. Aubin (of which church she was the foundress), which was made soon after her death, and restored in 1103. In the original, the sleeves were red, the cloak blue, and the head-dress and shoes amber-coloured. Our Coloured Plate of Queen Radegunde, the wife of Clotaire I.,* taken from an illumination of the eleventh century, represents nearly the same costume, with the exception of the head-dress and the guimple. She is seated in her chair of state, and holds in her right hand the stylus, with which she is writing on the tablets of wax which she holds in her left hand. The queen's dress is most remarkable for its richness, and new materials were now being introduced through Italy from the East. Among its most characteristic ornaments are the circular plates of gold, adorned with jewels—probably pearls. It was the fashion at this time to wear fillets, also ornamented with precious stones, round the forehead and head.

ADELAIDE DE VERMANDOIS.

The invasions of the Normans in France had, as I have already remarked, been one of the great causes which contributed to give birth to feudalism. Within a short period they had made themselves masters of a considerable part of the territory of the Franks, and established in it an independent sovereignty. As the Normans became settled, they abandoned their old northern manners and language, and adopted the French costume, the French tongue, the

* This plate will be given with the next number.

feudal form of government, and the Christian religion; and with so much zeal, that, in the eleventh century, Norman was the purest dialect of the *langue-d'oil*, or northern French; feudalism existed in Normandy in its purest form, and the Norman clergy bore the highest character of any in Europe. We have hardly any information on the condition of the Norman women; but a few anecdotes which have been recorded display no great refinement in female society, nor do the ladies appear to have been treated with much delicacy by the other sex. The second Duke William, afterwards William the Conqueror, who was illegitimate, married Matilda, daughter of Baudouin, Count of Flanders. It is related that, when this match was proposed to the lady, she refused indignantly to be married to a bastard; whereupon William, in great fury, waited at the door of the church which she had entered to perform her devotions, attacked her with brutal violence as she came out, threw her down, and continued beating her till she consentèd to become his wife. Matilda, in after life, when her husband had become King of England as well as Duke of Normandy, acted on several occasions in opposition to his will. Ordericus Vitalis blames greatly the Norman women, who, while the barons and knights, their husbands, were engaged in the conquest of England, and remained there longer than pleased them, not only refused to go thither to join them, but sent messengers to tell them that their absence was becoming so irksome that, unless they returned immediately, they would substitute other men in their places. The Normans also appear to have submitted reluctantly to the ecclesiastical regulations in regard to marriages, for we may judge, by the provisions of Norman synods in the eleventh century, that the practice of divorce and repudiation without the licence of a bishop, and marriages contrary to the ecclesiastical canons, prevailed widely. According to the Norman historian, William of Jumiège, the first duke Rollo, married his wife Popa "in the Danish manner;" and the same writer tells us that his son and successor, the first duke William, was united to Sprota in the same manner.

The Normans brought their language and manners, along with feudalism, into England, and our island was soon covered with castles. Feudalism itself contributed greatly to the assimilation of manners among the aristocracy in different countries; and, during a considerable period, costume, and the forms, at least, of domestic life in England, in Normandy, and in France, were no doubt nearly identical. During this period, in fact, English were Anglo-Normans.

The costume of the Anglo-Norman ladies resembled, no doubt, that of the Franks, which we have described; and during the reign of William the Conqueror, it probably underwent little or no change. It was in that of his successor, William Rufus, that new and fantastic fashions began to make their appearance in Normandy and England; and in these countries, as among the Franks at an earlier date, the example was set, not by the ladies, but by the other sex. The Norman youth, set free from the firm rule of the first William, seem, under the second, to have run into all sorts of wild extravagance. The historian Ordericus Vitalis, who lived at the time, declaims with great bitterness against the effeminacy and viciousness of the young Normans and Anglo-Normans in the latter years of the eleventh century. "They parted their hair," he says, "from the crown of the head on each side of the forehead, and let their locks grow long like women, and wore long shirts, and tunics, closely tied with points. . . . . They insert their toes in things like serpents' tails, which present to view the shape of scorpions. Sweeping the dusty ground with the prodigious trains of their robes and mantles, they cover their hands with gloves too long and wide for doing anything useful; and, encumbered with these superfluities, lose the free use of their limbs for active employment. The forepart of their heads is bare, after the manner of thieves, while behind they nourish long hair, like harlots. . . . . Their locks are curled with hot irons, and, instead of wearing caps, they bind their heads with fillets." Ordericus had already told us that "a debauched fellow named Robert was the first about the court of William Rufus who introduced the practice of filling the long points of the shoes with tow, and of turning them up like a ram's horn;" and that from this circumstance he became known as Robert Cornard. William of Malmesbury, who lived about the same time, or a little later, also speaks of the dissolute character of the men of the reign of William Rufus, of their "flowing hair and extravagant dress," and of their shoes with curved points.

The ladies no doubt soon caught the madness of the other sex for extravagant fashions in costume; but, oddly enough, they seem to have escaped the censure of the ecclesiastics, and the old chroniclers pass them over in silence. We have, however, some pictorial records of the freaks of Womankind in regard to dress during the reign of William Rufus. In the British Museum there is a MS. volume (MS. Cotton. Nero, C. IV.) which contains two books bound together; the second an Anglo-Norman version of the Psalms, which may possibly be not older than the middle of the twelfth

century; but the first, which may have been executed in Normandy, though I think it is Anglo-Norman, is certainly of an early date—probably of the beginning of the same century. It is a very interesting series of drawings of scriptural subjects—in fact, illustrations of the Bible. They form a singularly-interesting illustration of the costume of that period. Three of them are copied in the accompanying cut, selected from different pictures and different parts of the book. The first is taken from a picture representing the Slaughter of the Innocents (fol. 14); the second is from the folio next following; and the third, to the right, is from folio 24. The dresses appear to be much the same as those of the

NORMAN LADIES IN THE HEIGHT OF THE FASHION.

Frankish female costume—the under tunic or robe, the outer robe, and the mantle; but one of the most distinguishing peculiarities of the costume is the extraordinary form of the sleeves of the outer robe, which had now received in France the name of *gone*, or *gonele* (our modern word *gown*). The sleeve terminates in a long pendent, which will be best understood by the pictures—sometimes so long that it reached to the feet. The gown itself, too, was often so long that it trailed upon the ground. It will be remarked, also, that the waists of these ladies are very slender, and closely fitted with the dress—it was at this time that stays were first introduced. We see now the women appearing usually without the coverchief, and when

exposed to view, the hair is always parted on the forehead, and turned on either side upon the shoulders. The hair on each side was often bound with fillets, or ribands, so as to hang backwards like two long tails. This is represented in the lady to the right in our cut, where the hair looks as though fitted into a case. It may be remarked that, although the nimbus shows that two of the figures of our group are saints, they are all dressed in the height of the fashion; but this was not at all contrary to ecclesiastical custom.

We have, curiously enough, the means of tracing the direction from which this new fashion in dress came to Normandy and England. There is a manuscript in the British Museum (MS. Harl., No. 2821) which contains a fine copy of the Gospels in Latin, accompanied with elaborate illuminations. It is considered to be Italian, and to belong to the tenth century. Among the illuminations are found examples of this curious pendent to the sleeves, which was introduced among the Anglo-Normans towards the close of the century following; so that the fashion had evidently travelled

LADIES OF THE SOUTH.

hither from the south. Two figures of females from this manuscript are given in the accompanying cut.* It thus appears that, following

* The first of these figures is taken from fol. 101, r° of the MS.; the second, the one on the right, from fol. 22, r°.

the old tradition that everything new came from Rome, the fashions in France and England at this time came from Italy and Provence. The lady to the right, in our cut, has a head-covering which descends behind almost to the bottom of her dress. It is equally worthy of remark that the outer dress of the lady on the right is ornamented with plates of gold set with pearls or precious stones, exactly like those of Queen Radegunde in our Coloured Plate;* and in this same manuscript (fol. 100, v°), we have a picture of St. Luke in a dress similarly ornamented; so that it appears not to have been confined to the female sex. It is another example of a fashion brought from Italy to the North-West.

In our next cut we have a figure of a Norman lady, taken from

AN ANGLO-NORMAN LADY IN FULL DRESS.

a manuscript in the possession of the late Mr. Douce, apparently of the early part of the twelfth century. Her robe appears trailing largely on the ground, and the pendent to the sleeve has so increased in length, that it requires to be tied up in a knot to prevent its interfering with the movements of the wearer as she walks. The mantle is here more capacious, and the plaited tail of hair is divided at the end into two parts. We have seen, at a rather earlier period, an ecclesiastic condemning the new fashions in dress as so many liveries of the demon. The illuminator who drew the scriptural illustrations in the Cottonian MS. (Nero, C. IV., fol. 18) evidently possessed a very satirical spirit; in the picture of the

* This plate will be given in our next number.

Temptation, he has introduced Satan himself dressed in his own livery—a lady's gown so extravagant in its dimensions that it was

A FASHIONABLE INDIVIDUAL.

necessary to shorten with a knot not only the sleeve, but the dress also, to prevent its trailing. The demon, in his new costume, is represented in our last cut. The stays, or the laced body of the gown, are here shown very distinctly.

THE ANORTHOSCOPE.

BY WILLIAM B. CARPENTER. M.D.,

Vice-President of the Royal Society.

(*With a Coloured Plate.*)

(*In continuation of the Zoetrope,* Vol. ii., p. 31.)

We have now to bring under the attention of our readers another instrument, based on the same fundamental principles with the preceding, which, although invented more than thirty years ago, is still much less generally known than it deserves to be, either to the scientific or to the general public.

This instrument, designated by its inventor, Professor Plateau, the *Anorthoscope,* is nothing else than an apparatus for making two wheels or disks revolve in opposite directions very near each other; the velocity of one, however, being a multiple of that of the other. Professor Plateau originally devised this little machine, of which he published a description in 1829, with a view to a class of effects analogous to those previously described by Dr. Roget (see Vol. i., p. 432), namely, the production of curves by the glimpses obtained of revolving radii, not through a succession of parallel slits, but through slits themselves revolving in an opposite direction to the radii, with a much smaller velocity. After having been led, however, by Professor Faraday's observations, to the invention of the Phenakisticope (see p. 24), Professor Plateau perceived that his machine might be applied to the production of an entirely new class of effects; namely, the conversion of *distorted* figures, such as that shown in the upper half of the Coloured Plate, into such *normal* shapes as that shown in the lower.* The distorted figure is drawn, according to a principle that will presently be explained, on the *back* disk, which is rendered semi-transparent by varnish; and is made to revolve *four* times, while the *front* disk, which is opaque and black, with four slits disposed in this manner — | —, revolves *once.* When the disks are put in motion, with a strong light behind the back disk, *five* stationary images, arranged in a circle, each image having its normal proportions, are seen through the front disk. This production of normal from distorted figures, combined with their multiplication, sometimes gives rise to most

* Bulletins de l'Academie Royale des Sciences de Bruxelles, tom. III. (1836), p. 7.

unexpected results, as in the case represented in Fig. 1; for no one, without having studied the principle of these results, would be

FIG. 1.

likely to guess that the spiral curves would come out as the straight edges of ten playing-cards, and the deformed spots as their pips, as shown in Fig. 2.

It is not difficult to understand the *rationale* of these curious results, when we give a little attention to the effect which the multiplied velocity of the disk bearing the figure must have upon the coincidence of any point in that figure with any point in the disk through which it is seen. For the sake of convenience, we shall assume that the latter has only one slit, and that its velocity is to that of the disk carrying the figure as 1 : 4; and we shall consider the entire circle described by either as divided into 20 parts, numbered from 1 to 20 in the direction of a clock-face. Now, let any point *a* of the figure on the hinder disk be seen through the slit in the front disk when both are at 20, and let the former travel from left to right (in the direction of the figures), whilst the latter

travels from right to left; then it is obvious that whilst the slit moves from 20 to 19, the point a will have moved from 20 to 4, and that by the time that the slit has passed through 4 divisions, so as to reach 16, the point a, moving in the opposite direction with four times the velocity, will have passed through 16 divisions, and will therefore be again seen through the slit. In like manner, by the

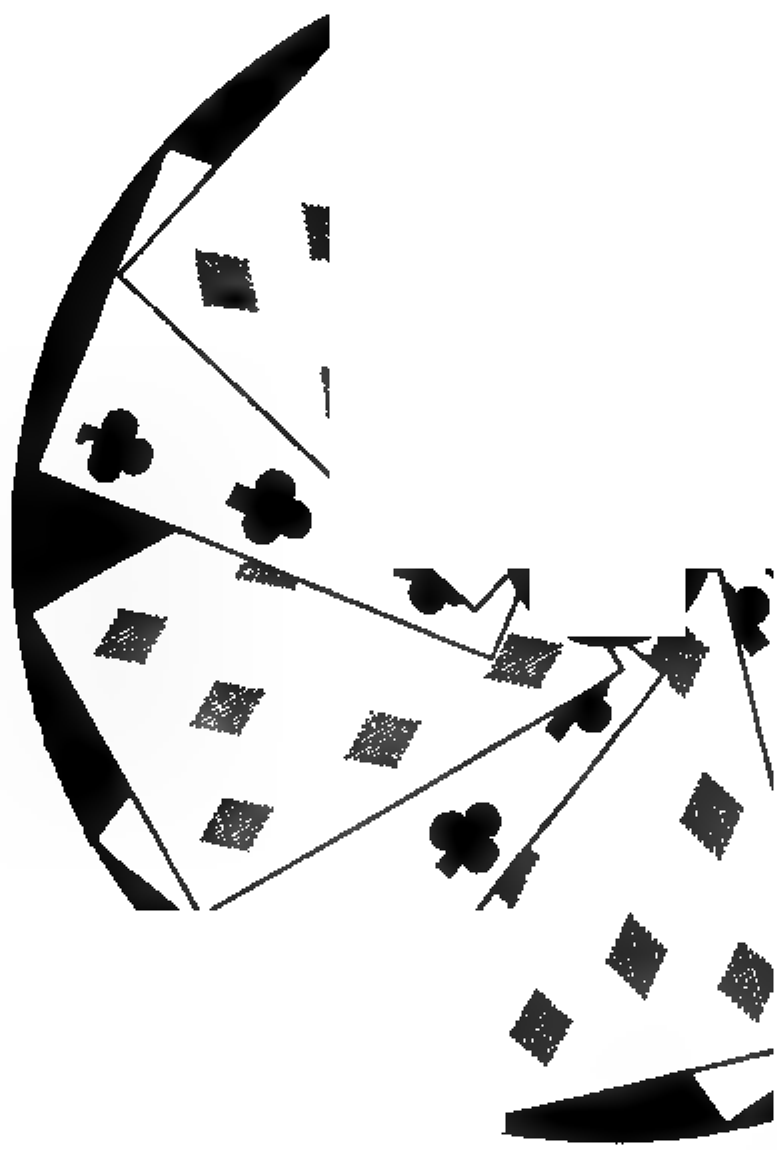


FIG. 2.

time that the slit has reached 12 in the backward direction, the point a, having moved onwards through 16 divisions, will reach 12 in its second revolution, so as again to be seen through the slit; a third coincidence will take place at 8 in the third revolution of the figure-bearing disk; a fourth coincidence at 4 in its fourth revolution; whilst the completion of that revolution will bring the point a again to 20 precisely at the same time as the slit reaches it, after having made but a single revolution. Thus, during one turn of the front disk, the eye will have received five glimpses of the point a, at angular intervals of 72° from each other; and the same will of course be true in regard to every other point of the figure on the

1

2

ANORTHOSCOPE FIGURES.

back disk. Further, if instead of one slit in the front disk, we have either *two*, *three*, or *four*, the effect remains the same, provided that these slits be so arranged that the angular interval between them is either 90° or 180°; for it is obvious that, whether the slits be disposed as |, or as | —, or as — | —, or as — | —, the coincidences between the slits and any given point *a* on the back disk will still recur at the same parts of the revolution, so as to give a stationary image, of which the augmentation in the number of the slits up to this point simply increases the vividness, by making the recurrence of the glimpses more frequent. But if the number of slits were augmented beyond four, or they were disposed at any intermediate angles, the coincidences would not recur at the same parts of the revolution, and the whole effect would be deranged.

Fig. 3.

If, now, we consider the relation of either of the slits in the front disk to any other point *b* in the distorted figure on the back disk, at a given angular distance from *a*,—say 60°,—it becomes obvious that this angular distance will be reduced, in the image

seen through the slit, to *one-fifth* of that which it has in the figure, namely, 12°; for whilst the slit moves backwards through that angle, the point *b* will have travelled onwards through 48°, so as to become visible through the slit. And thus each of the multiplied images, instead of resembling the original figure, will have its sides drawn together, so to speak; so that, in place of a distorted figure occupying the whole disk, we see five similar normal figures, each contained within a sector of 72°, or one-fifth of the disk. This is most simply illustrated by such a disk as that shown in Fig. 3, from which two sectors, each of 90°, have been cut out, leaving two intermediate sectors of the same angle; for when this is viewed in the Anorthoscope through the slits of the front disk, *ten* openings

Fig. 4.

are seen (Fig. 4) instead of two, the radii which bound them having been closed together from 90° to 18°. It will be noticed that there is here but a very slight change in the *form* of the apertures, beyond that occasioned by the contraction of their angle; their sides being straight, and their peripheral margins being circular, as

in the actual disk. But their central border has undergone a curious alteration, the two straight lines meeting at a very oblique angle being replaced by two curves meeting in a sharp point. It is obvious that a reduction in the angular distances of the several points of the original figure will not produce any distortion, either of straight lines drawn from the centre to the circumference, or of circles or parts of circles concentric with the disk. But it can be readily shown, that any straight line except a radius will have the relative position of its several points so altered by the reduction of

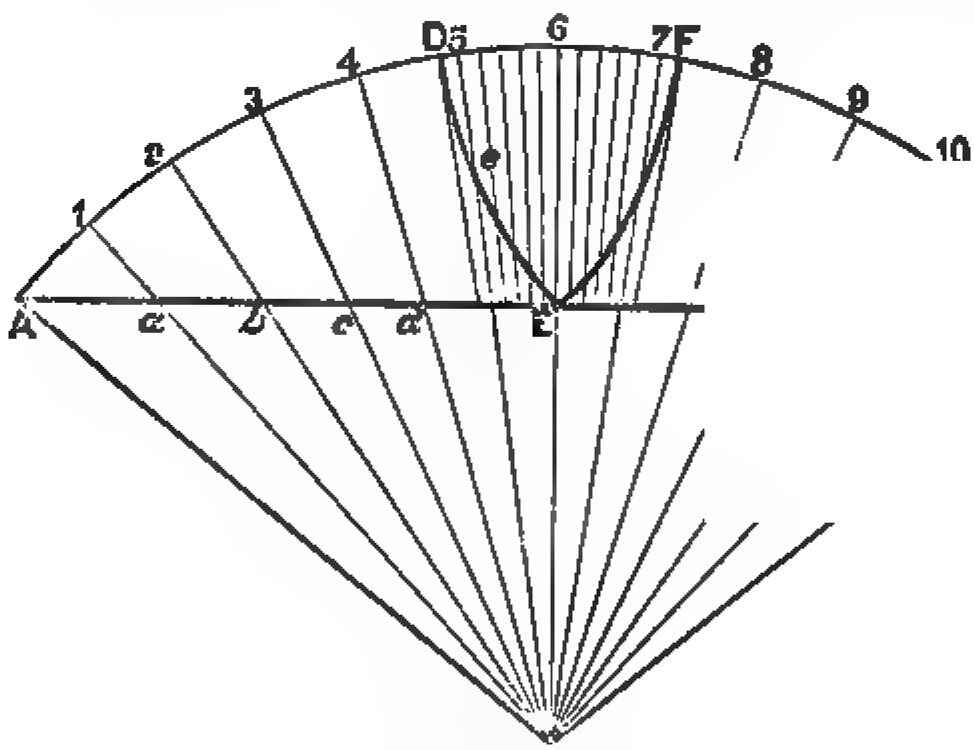


FIG. 5.

their angular distances, as to be seen as a curve. Thus in Fig. 5, let C be the centre of the back disk, C A and C B two of its radii, and A B a chord joining their extremities; this straight line will be represented in the image seen through the slits by the double curve, D E F. For let the whole arc, A B, be divided into five parts, of which D F is the middle part; then it is obvious (on the principle already stated) that D F will be the *angular* distance between the two extremities of the line which represent A B, and that the imaged line must lie entirely between those points. But the course of that line will depend upon the intersection of its *angular* and its *radial* distances; and the latter are to be found by dividing the whole arc, A B, and its fifth part, D F, each into any number of parts,—say twelve,—and setting off the distances 1 *a*, 2 *b*, 3 *c*, etc., of the intersections of the eleven radii, C 1, C 2, C 3, etc., with the line A C, upon the eleven radii drawn at one-fifth of

the angular interval between D and F.* Thus, as the point D will be seen in the place of A, if we set off upon the radius C 5 the distance 1 *a*, it will give the point *e*, corresponding with *a*, and so with the four succeeding lines until we come to E, where the radial distance of the imaged line will correspond with that of the actual line; and the five successive radial distances between C 6 and C B being set off in like manner upon the five radii between C 6 and C F, the points thus marked will represent in the image the points in the actual line B which are intersected by the radii. If a line be drawn through the marked points, it will give the double curve D E F, which thus represents the successive points of the line A B on the back disk, as seen through the slits of the front disk, when made to revolve in the opposite direction with one fourth of its velocity.

Conversely, a *curved* line may be so drawn on the back disk, as to be seen through the slits of the front disk as a *straight* line. Thus,

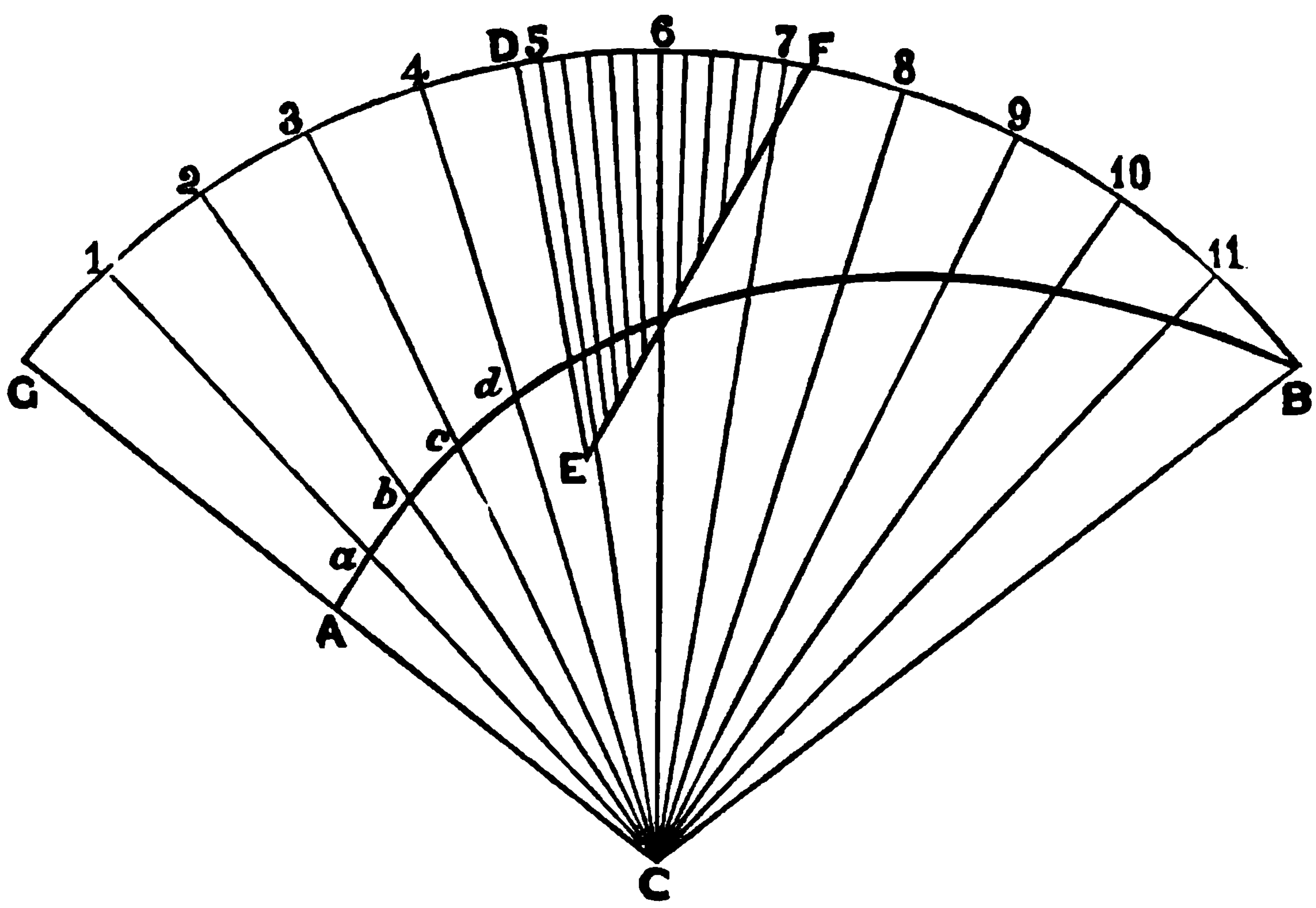


FIG. 6.

in Fig. 6, the curved line A B will be represented by the straight line E F. For the same construction being made as in the preceding case, the distance C E being set off upon the radius C D, the point E will represent in the image the extremity A of the curved line, whilst the point F represents the extremity B, which joins the circumference; and the course of the intermediate line

* It is, of course, immaterial whether these distances be set off from the centre or the circumference. The latter mode is adopted in the figure, merely to prevent the crowding of the approximated radii towards the centre.

will be found by setting off the radial distances, 1 *a*, 2 *b*, 3 *c*, 4 *d*, etc., of the eleven radii between C G and C B, upon the eleven radii approximated to one-fifth of the angular distance of the preceding, between D and F. A line drawn through the points thus marked will be a straight line; and this will represent the successive points of the curved line A B, as seen through the slits of the front disk revolving as before.

This being understood, the principle on which the distorted drawing shall be constructed, that is to be represented by five multiple images of normal form, becomes readily comprehensible. Suppose we wish the image to have the simple quadrangular form

Fig. 7.

of an ordinary card (*a*, *b*, *c*, *d*, Fig. 7), we first draw through its centre the radius C *b*, and on either side of this we draw a series of radii, C 1 to C 13, at any convenient angular intervals,—say 5°,—so as to intersect its boundaries. Then, on either side of the radius C *b*, we draw the radii C 1′ to C 5′, and C 7′ to C 13′, at five times the angular interval of the preceding, namely 25°; and by setting off

upon the latter the radial distances at which the former intersect the boundaries of the original figure, we shall have a series of corresponding points at equal *radial* distances, but at five times the *angular* distances, the corner *a* being carried to *a′*, the corner *c* to *c′*, the corner *d* to *d′*, whilst the place of *b* remains unchanged; and by drawing curves through these points, we obtain the outline of the distorted figure, which, when made to revolve in the Anorthoscope at four times the velocity with which the front disk revolves in the opposite direction, will present the original rectangular

FIG. 8.

figure, *a*, *b*, *c*, *d*, five times multiplied. In Fig. 8 is given another example of the same kind, to show how easy it is thus to produce the required distortion in a figure of any shape; so that when viewed in the Anorthoscope, the normal figure may be reproduced; all that is needed being that the *radial* distance of each of the principal points, *a*, *b*, *c*, *d*, etc., of the figure shall be determined by drawing a radius through it; and that these distances shall be marked off, as at *a′*, *b′*, *c′*, *d′*, etc., upon radii drawn at five times

their respective angular distances from a radius (C *h*) drawn through the central part of the figure, which is taken as the point of departure.

In a later memoir,* Professor Plateau has more fully worked out the theory of the Anorthoscope, and has presented it in a mathematical form. Into this discussion, however, we do not think it necessary to enter, since its most important results may be deduced more simply from the explanations already given. Thus it is obvious, that any variation in the relative velocities of the two disks will involve a corresponding modification in the image; the reduction of the angular distance, and the multiplication in the number of images, being always expressed by the *sum* of the relative velocities of the two disks, so long as they revolve in *contrary* directions. Thus, when they move with *equal* velocities, 1 : 1, there will be *two* coincidences in each revolution, so that the angular distances will be reduced *one-half,* and the image will be *doubled* (as in Faraday's wheels); so that the disk shown in Fig. 3 will have *four* light and *four* dark spaces. If the velocity of the back disk be to that of the front disk as 2 : 1, there will be *three* coincidences in each revolution, the angular distances will be reduced to *one-third,* and the image will be *tripled;* so that Fig. 3 will be seen as a wheel with *six* light and *six* dark spaces. And if the velocities be as 1 : 3, as there will be *four* coincidences in each revolution, the angular distances will be reduced to *one-fourth,* and the image will be *quadrupled,* so that Fig. 3 will be seen as a wheel with *eight* light and *eight* dark spaces. The same rule will hold good for any higher numbers. The original figure, however, should never be allowed to extend beyond the sector, which, when multiplied, will make the entire circle; thus in Fig. 8, we see that if it had extended much beyond the radii C 1 and C 15, which are 70° apart, the quintupling of the angular distances would cause the extreme points of the distorted figure, which closely approximate to each other at *a′* and *p′*, to overlap. Further, the number of slits in the front disk must not exceed the multiple ratio of the velocity of the back disk to that of the front, otherwise the coincidences will occur in points that do not correspond. And their angular distances must always be in the same ratio; thus, if the velocity of the back disk be *three* times that of the front, there should not be more than three slits, and they should have an angular interval of 120°. One or even two of these

* "Bulletins de l'Académie Royale de Belgique," 1849; Classe des Sciences, p. 198.

slits may be covered, as already explained (p. 113), without any other result than a diminution in the brightness of the image, consequent upon the reduction in the frequency of the glimpses of it received.

The peculiar effect of the Anorthoscope, however, may be also obtained by making the two disks revolve with differing velocities in the *same* direction; but the reduction of the angular intervals and the multiplication of images will then be in the ratio, not of the sum, but of the *difference*, of the two velocities. This may be very easily shown in the ordinary Anorthoscope, by so placing the band which goes over the pulley of the front disk as to make it give *direct* instead of *reversed* motion to that pulley; and it will then be found, that as the velocities of the two disks are as 4 : 1, the number of light and dark spaces in the disk, represented in Fig. 1, will be *tripled*, the angular distances of their radial borders being reduced to *one-third*. The *rationale* of this is at once made apparent by working out the coincidences of either of the slits in the front disk with any given point *a* in the figured disk. For if both start from a coincidence, it is obvious that, as *a* moves four times faster than the slit and in the same direction, *a* will have gone through an entire revolution and one-third of another ($360°+120°=480°$), whilst the slit has moved through 120°; that a second coincidence will happen when the slit has moved through another 120°; and that a third will occur when it has completed one revolution. Thus the point *a*, like every other point on the figured disk, will be seen three times in one revolution of the front disk; and in like manner the apparent angular distances between any two points *a* and *b* will be reduced to *one-third*, causing a multiplication in the number of images by *three*, and a reduction in the distortion to the same amount. It is curious to see how the figures which have been distorted by the *quintupling* of their angular distances, are thus brought nearer to their normal form, without being fully restored to it.

This law of differences applies to any multiple ratio between the velocities of the two disks revolving in the same direction. It is obvious that if they both revolve with the same velocity, no image whatever will be seen. If their velocities be as 2 : 1, there will be but a *single* coincidence between the slit and any point *a* of the figured disk in each revolution of the former; and thus only a *single* image will be seen, corresponding with the figure. If they be as 3 : 1, there will be *two* such coincidences; for the figured disk will have made one revolution and a half, whilst the slit makes a half revolution; and thus there will be a *doubling* of the

image, and a *halving* of the angular distances of its parts. The like rule holds good for any higher ratio : thus, in order to reduce the distorted figures already described to their normal form by revolution of both disks in the same direction, the figured disk must go round *six* times while the slit revolves once. We shall thus have *five* coincidences in each revolution of the slit, the image will be multiplied *five* times, and its angular distances will be reduced to *one-fifth* of those of the distorted figure, just as when the disks revolve in *opposite* directions with velocities of 4 : 1.

An entirely opposite, and still more curious set of effects is produced when the two disks revolve in the same direction, with velocities nearly equal, the front disk moving the more rapidly of the two; for, instead of a *multiplication* of figures, and a *reduction* of the angular distances of their parts, we shall now have a *combination* of multiple figures into one, and an *extension* of the angular distances of their parts, the number and proportion being governed by the ratio of the velocities of the two disks. Thus, if the revolutions of the front disk be to those of the back disk as 4 : 3, four figures, each contained within a quadrant of the back disk, will be combined into a single image, which will be made, by the quadrupling of the angular distances of its parts, to extend over the entire circle. The conversions thus effected are yet more strange than

FIG. 9. FIG. 10.

any that are produced by the opposite process; thus none but an expert in this particular subject would conceive that by any such simple transformation, the design shown in Fig. 9 could be made to represent the word shown in Fig. 10.

The *rationale* of this conversion will not be found difficult of comprehension, if there has been a thorough understanding of all that has gone before. Let us suppose that the back disk is divided into quadrants by the four radii, C *a*, C *b*, C *c*, and C *d*; and that the

front disk has but a single slit, which, at starting, coincides with C *a*: then it is obvious, that whilst this slit makes an entire revolution in the direction *a, b, c, d,* the back disk will have made only three-fourths of a revolution in the same direction, so that when the slit again comes into the position C *a*, it is the radius C *b* of the back disk which coincides with it, so that, whilst making its entire revolution, the slit has passed over only the quadrant *a b* of the back disk. In like manner, after another revolution of the slit, it will be the radius C *c* which comes into coincidence with it, and the quadrant *b c* of the back disk which it has passed over. A third revolution of the slit will make it gain upon the back disk, so as to pass over the quadrant *c d;* and in a fourth revolution it will pass over the quadrant *d a*. Now, it is easy to see, that if four similar figures be drawn, one in each of these quadrants, the corresponding points in the several figures will pass beneath the slit at precisely the same parts of the four successive revolutions; and as they will thus produce repeated coincident impressions, a single image will be the result. Further, the picture on each quadrant will be spread out (so to speak) around the entire circle, so that all its angular distances will be quadrupled, its radial distances remaining the same: thus, a wheel with *eight* light and *eight* dark spaces will give an image resembling Fig. 3, for the two light and two dark sectors in each quadrant, each having an angle of $22\frac{1}{2}°$, will have their several angles opened out to 90°; and the images of those formed by the four successive quadrants will coincide to form a single picture, in which there are but two light and two dark sectors, each of 90°.

Further, what is true of a single slit in the front disk will be true of each of three slits disposed at angular distances of 120°. For if we call these slits, 1, 2, 3, and start from the coincidence of slit 1 with the radius C *a* of the back disk, it is obvious that (as the rates of revolution of the front and back disk are as 4 : 3) by the time that the *front* disk has made one-third of a revolution, so as to bring slit 2 into the position from which slit 1 started, the *back* disk will have made one-fourth of a revolution, so as to bring the radius C *b* opposite to it; and that, in like manner, when slit 3 arrives at the same position, the radius C *c* comes into coincidence with it. When slit 1 had made an entire revolution, the radius C *b* comes into coincidence with it, as already shown; and the whole sequence repeats itself in the same manner. Hence, as the same effect is produced by the passage of each slit in the front disk over each quadrant of the back disk, and as the effects are repeated at precisely the same

points of each revolution, the multiplication of slits—as in the cases previously described—only increases the vividness of the image. But if the slits had any other number than that which represents the rate of revolution of the slower disk, or were placed at unequal angles, it will be obvious, on a little consideration, that the coincidences would not take place at corresponding points of the figures, and that no distinct image would be produced.

For the production of these effects, it is necessary that the *difference* in the velocities of the two disks should be a submultiple of both of them; and this will, of course, be the case when they differ by *unity*, so that a given number of revolutions of one disk shall correspond precisely with the same number, *minus* 1, of revolutions of the other. Thus, the ratio may be as 3 : 2; 4 : 3; 5 : 4; 6 : 5; and so on; but, in practice, the ratio 4 : 3 will be found most convenient. The number of repetitions of the distorted figures must be that of the revolutions of the front disk; and the angular distances of the several points in each figure must be reduced in the same proportion, so as to bring it within its own sector of the disk. The mode of drawing the distorted figures is, of course, the converse of that according to which Figs. 3—8 are constructed; for the actual figure (which may occupy the entire area of the disk) being traversed by radii drawn at convenient angles, a sector of the disk, inversely proportioned to the rate of revolution of the slits, is to be traversed by radii drawn at proportional angles. Thus, if (as in the case represented in Figs. 9, 10) the ratio of the two revolutions be as 4 : 3, the figures must be repeated *four* times, each being contained within a quadrant of the circle; and the angular distances of each must be reduced to *one-fourth* of those which the combined image is intended to present. Let us take a simple case:—To draw the distorted figure which shall produce the image of an eccentric circle, *a, d, c, e, b* (Fig. 11), that circle is to be traversed by radii drawn at (say) 10° distance from one another, whilst in one quadrant of the disk are to be drawn the same number of radii at $2\frac{1}{2}°$ distance; then the radial distances of the several points at which the circle is intersected by the first set of radii being set-off in the same order upon the second, we describe the curve *a′ d′ c e′ b′* through those points; and if the disk bearing this curve on either of its quadrants be made to revolve with the velocity of three, behind the front disk revolving with the velocity of four in the opposite direction, the image of the entire circle will be reproduced. But as the other three quadrants of the disk pass before the eye without renewing that impression, the image is rendered faint by the in-

frequency of its recurrence; and to render it more vivid, the same curve should be repeated in the other three quadrants, as at $a' \ c' \ a'$, $a'' \ c'' \ b''$, $b'' \ c''' \ b'$. As each of these quadrantic repetitions pro-

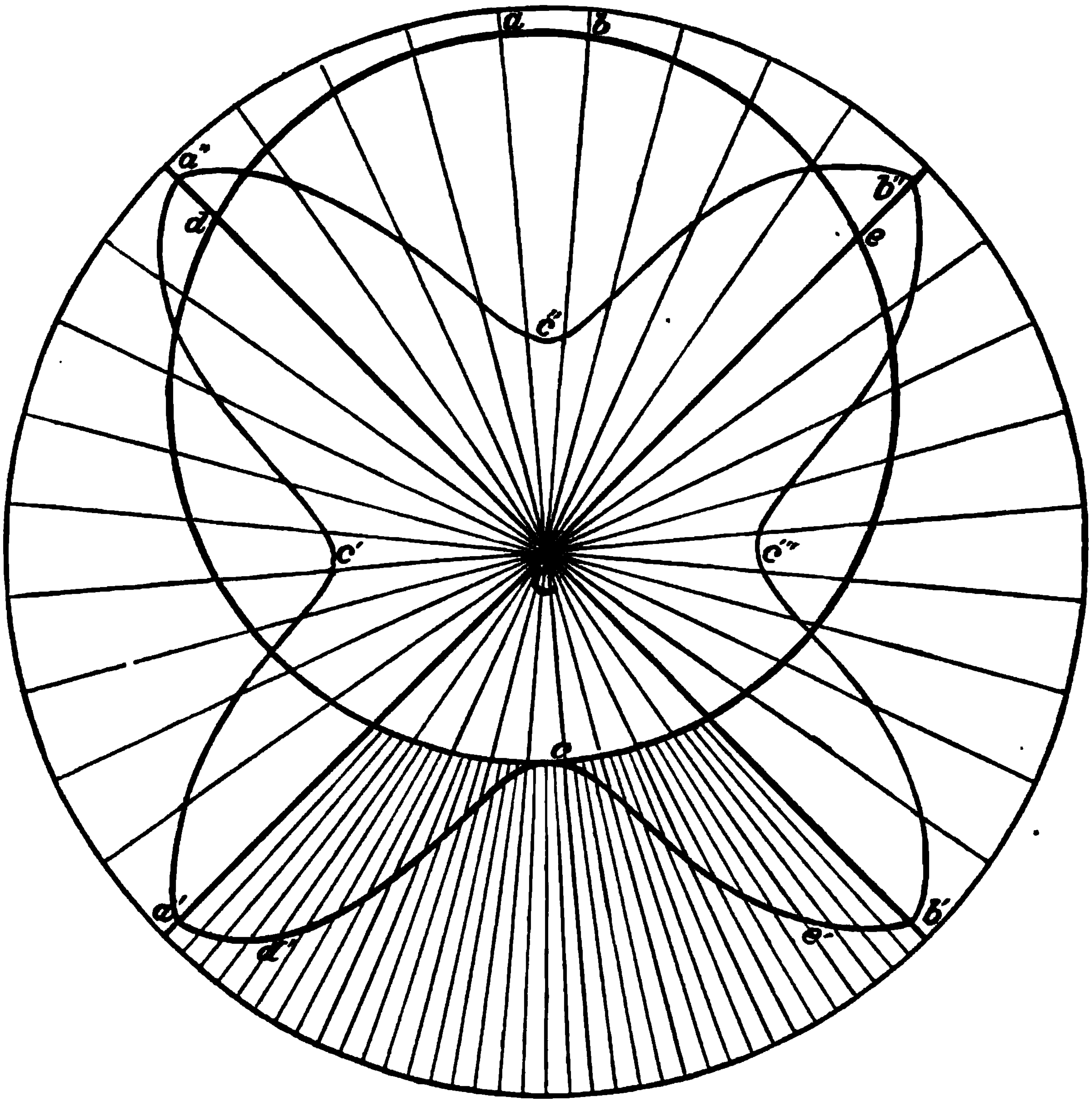


Fig. 11.

duces an image of the entire circle which is identical in size and position with that produced by the others, their succession occasions no confusion, but, on the other hand, an increase of vividness. If the original figure does not extend in every direction round the centre of the disk, the distorted figure will not extend through the entire quadrant; and parts of the figure which are separated in the original will be alike separated in the distorted figures drawn within the quadrant, and in the reproduced image. Thus, the L and the I (Fig. 10) will be represented by four separate but similar distortions, as shown in Fig. 9; whilst the outer border of the O, being itself a circle, will remain a circle, the four quadrants which represent it being similar and equal; but its inner border will form eight deep crenations, the two halves of its ellipse being made, by the reduction of the angular distances, to form a double crenation

in each quadrant, while the junction of these crenations in the four quadrants produces the central figure in Fig. 9.

It has been further shown by Professor Plateau that the principle of his Phenakisticope may be combined with that of his Anorthoscope; so that the single image produced in the manner just described, instead of being fixed, may have the appearance of motion. For if the distorted figures, instead of being all similar, are drawn with variations in the relative positions of their parts, upon the principle already described (p. 24.), the single image formed by their successive passage before the slits will acquire movement like the repeated figures of the Zoetrope. But as this effect can be much better produced when the figures are more multiplied, so that the transition from one phase to another can be made more gradual, another arrangement has been devised by Professor Plateau, which he states to be extremely successful. The two disks are made to revolve in *opposite* directions; and the angular movement of the figured disk, instead of being a multiple of that of the slit through which its figures are seen, is now only one-fourth of that rate. It can be readily shown, upon the principles already explained, that, to produce a normal image, the angles of the deformed figure must be to those of the original as 5 : 4, or as 20 to 16. If, now, sixteen figures be drawn, each of such a size as to fall within a sector of one-twentieth of the figured disk, and having the gradational variations proper for the Phenakisticope or the Zoetrope, and these figures be transferred to the disk with an opening-out of their angular distances in the ratio of 5 : 4, each will occupy a sector of one-sixteenth of the circle, and will be momentarily seen *in succession* through the slit. For suppose the *first* slit to coincide in the vertical position with the *first* figure; by the time the front disk has made one-fourth of a revolution, the *second* slit will have arrived at the same vertical; and as, in that same timo, the figured disk will have made one-sixteenth of a revolution in the opposite direction, its *second* figure will be seen through a slit in the same place as the first. Another quarter-revolution of the front disk will bring its *third* slit to the vertical, and at the same time the *third* figure of the back disk will arrive at the same vertical, so as to be visible through the slit: and, on the arrival of the *fourth* slit at the same vertical, the fourth figure will become visible through it. The completion of the revolution of the front disk will bring its *first* slit to the vertical again; and, as the figured disk will then have completed one-fourth of its

revolution in the opposite direction, its *fifth* figure will be seen through the slit; and it is obvious that all the sixteen figures will be thus successively presented, until, the figured disk having completed one revolution, the first again comes into view.

In order that this illusion may be presented with the greatest effectiveness, it is desirable (1) that the back disk should be transparent, and the figures on it painted in transparent colours; (2) that a strong light should be transmitted through that part of it which forms its 1-16th vertical sector, and should be so limited to that portion by a screen, that no other part of the disk shall be visible; (3) that there be no other light in the apartment; and (4) that movement be given to the disks by wheel-work instead of by pulleys, so as to secure more perfect coincidences than the latter arrangement will give. When these conditions are attended to, the image may be seen by many persons at once; and if the figures be drawn with due regard to the effect they are intended to produce, the result is said by Professor Plateau to be truly marvellous, and far to surpass that producible by the Phenakisticope. Thus he tells us that, having obtained from a good artist the picture of a demon blowing a fire with the full force of his breath, he so modified it in the successional reproductions, as to imitate the different stages of the natural action. Thus, when the head seems to be blowing, it bends forwards, the cheeks swell, the lips project, the eye-brows frown, and the eyes direct themselves towards the fire; the flame of which jets up, and throws a strong light on the under parts of the head nearest to it, producing deep shadows on the remoter parts. When, on the contrary, the head raises itself to take breath, the cheeks collapse, the mouth opens, the eyebrows rise, and the eyes direct themselves towards the spectator; the flame drops at the same time, the fire burns less brightly, and the lights and shadows on the head are less pronounced. Thus, says Professor Plateau, "Mon petit souffleur, a-t-il excité une véritable admiration chez les personnes que l'ont vu fonctionner."

It would be quite feasible, as Professor Plateau goes on to show, to devise an arrangement by which a moving image of this kind should be presented *in stereoscopic relief*. To obtain this result, the pictures must be drawn in pairs, with the proper stereoscopic difference, or, still better, a series of stereoscopic pairs should be taken photographically from a model posed in the requisite succession of attitudes; and two Anorthoscopes should be arranged in the manner already described, so as to present the successive pairs

of corresponding pictures at the two sides of Professor Wheatstone's Reflecting Stereoscope. These pictures, being reflected by its mirrors to the two eyes of the observer at the same time, will produce an image in relief, the parts of which will seem to be in continual movement.

The principle of the Stereoscope and that of the Phenakisticope, however, may be brought into combined action in another and simpler manner. The writer remembers to have seen, at the Royal Society, some years ago, an arrangement devised by Mr. Shaw, in which the image of a model of a steam-engine in motion was presented in the ordinary small Lenticular Stereoscope, by mounting a series of stereoscopic pictures of the model, taken in successive stages of its action, upon the outside of a drum, which was made to revolve under the Stereoscope; the aperture of that instrument being so narrowed, that, as in the Zoetrope, each picture should be only momentarily glimpsed in passing before it. The chief defect in this apparatus consisted in the deficient illumination of the pictures.

Now we would suggest it to those who, being interested in the commercial success of the Zoetrope, may be desirous of introducing some novelty which shall give a renewal of its attractions for the next season, whether, in place of the very inartistic designs at present thought good enough for the amusement of its purchasers, it might not be worth their while to obtain a series of Photographic pictures from a good model *posed* in the required variety of attitudes. Effects far more striking than that of Professor Plateau's *petit souffleur*, because more truly life-like (requiring no distortion in the figures), might thus be obtained.

But, further, it appears to the writer that Stereoscopic relief may be given to the moving images, by an arrangement far less cumbrous than Professor Plateau's, and more effective than Mr. Shaw's. For let such a series of photographs be taken in pairs, so that each pair shall combine stereoscopically, whilst their succession is so adjusted as to produce the desired effect of motion; and let these pairs be disposed (*between* the slits) on the inside of a drum, open at both ends, and made to revolve upon a *horizontal* axis. Then, if a pair of stereoscopic semi-lenses, having a focus sufficiently long to reach to the opposite side of the drum, be so fixed near its outer surface that the slits shall pass successively beneath them, the right eye will see the right-hand picture, and the left eye the left-hand picture, through the portions of the slit

which pass under them respectively, and the two pictures will be brought into superposition by the semi-lenses. As light may be made to fall on the pictures from each end of the drum, there need be no difficulty in regard to illumination. We commend this suggestion to the attention of our enterprising Opticians, and see no reason why it should not be successfully worked out.

ALLEGED FIRES FROM SOLAR HEAT AND SPONTANEOUS COMBUSTION.

During the late hot weather it became a newspaper custom to speak of fires all over the country as caused by "solar heat," as if the sun had really raised the temperature of fields, commons, forests, and buildings, to such an extent that their combustible materials became ignited without actual contact with any burning body. In other cases "spontaneous combustion" has had the credit of a conflagration, as in Captain Shaw's report of the fire which occurred at the Brighton Railway Station, London Bridge. It is surprising how little those who write about "fires from solar heat," or those who believe their reports, reflect upon the temperature at which wood, paper, dry grass, or other common materials can be made to burn in atmospheric air; and it is also surprising how readily "spontaneous combustion" is credited with disasters that are much more likely to have arisen from a more common-place and less mysterious cause.

What solar heat has really done, is to bring a mass of combustible matter to so dry and warm a condition as greatly to increase its facility of being kindled, and to diminish the chances of its going out if a single particle is once brought to the stage of ignition. In ordinary seasons, "sparks" are often supposed to set houses on fire, though if any one tries to set light to a sheet, or a tablecloth, or mass of deal shavings, by dropping sparks upon them, very little success, beyond burning a small hole, will be achieved. The reason is obvious. The quantity of heat conveyed by a spark is very small, and in the usual weather of this country the moisture in the air, at moderate temperatures, effectually prevents anything exposed to it from being really dry. Hence when a spark falls upon any of the objects mentioned, a considerable portion of its heat is expended in evaporating moisture, and some more is lost by

conduction, so that the balance left, though capable of charring a small surface, or burning a little hole, is not sufficient to set up active combustion, and make a blaze. Unless sparks fall upon materials more combustible than the articles named, they can rarely be the true cause of a fire; though, if they should fall upon loose cotton, tow, or other very bad conductors of heat, in a favourable state for ignition, they may readily produce a smouldering fire, which a breath of wind may convert into a blaze. Supposing a small particle of matter to be ignited by a spark, the fire will be communicated to the adjacent particles, if the heat developed by the combustion of the first particle is sufficient to raise those particles to the requisite temperature, in spite of loss by conduction, evaporation, etc. In the old times of the tinder-box, flint, and steel, housewives were very careful to keep their tinder dry. The tinder was usually composed of a carefully charred rag, and was, consequently, a very bad conductor of heat. The spark obtained by striking flint and steel is a little globule of the incandescent metal; and if our microscopic readers have never seen it, we recommend them to strike a light forthwith, and illuminate their minds on the subject. The striking process should take place over a sheet of paper, and the particles collected and viewed as an opaque object. It will be found one of great beauty. Spheres of bright steel, like cannon-balls, will be seen lurking amongst the angular crags of the broken flint. Now in this case a particle of molten steel, at a very high temperature, is the exciting cause of the tinder's ignition, and yet we all know, by tradition, if not by experience, that unless the tinder was very dry the experiment used to fail. Even with gunpowder in the days of flint-locks, there were frequent failures in attempts to let off fire-arms in damp weather, and the well-known maxim of "trust in Providence, and keep your powder dry" shows how thoroughly the law of nature on this matter was understood.

Substances vary in combustibility, but happily for the comfort of the human race, those used in the construction of dwellings, furniture, clothing, etc., cannot be ignited, except at a temperature very far exceeding that produced by the direct rays of the sun in the hottest lands. To give a practical illustration to these facts, we place a few pounds of mercury in an evaporating dish over a Bunsen burner, and immerse a thermometer in the liquid metal to show how the temperature rises. A piece of common writing-paper is floated on the top of the mercury, and occasionally submerged by giving it a poke with the stick of a lucifer match. At a temperature of 420°

the paper becomes delicately tinged with brown, but the charring process does not go on fast till between 500° and 600°, at which it takes place with great rapidity. Except by shrinking and cracking, no woody fabric would be injured by a heat of 400°, and yet we are called upon to believe that the sun's rays have fired houses, fields, and even forests! We do not know where credulity, arising from ignorance of natural laws, may stop, but perhaps the belief of few would go far beyond the story of the gentleman whose umbrella caught fire through "solar heat" having made the steel ribs red-hot.

In the last STUDENT it was shown that the greatest manifestation of solar heat at Greenwich was the raising a black bulb thermometer *in vacuo* to the extent of 168°. This is an enormous heat for the sun to produce in any body without the aid of a burning glass or mirror, but is much less than half the temperature to which hay, straw, paper, wood, etc., might be safely brought, so far as danger from conflagration was concerned.

Radiation takes place with great facility in a vacuum, and, of course, the moment the supply of heat is lessened, counter radiation from the heated body rapidly cools it. Mr. Glaisher, in the Greenwich experiments, laid his black bulb thermometer on the grass, and we may doubt whether any grass or tree in this country was heated as much as his thermometer at its maximum, because no grass or tree was placed in a vacuum to facilitate the passage of solar heat to it, and no grass or tree could have been as perfectly screened from air currents as the bulb of his thermometer was. If Mr. Glaisher's object had been to ascertain the greatest possible heat which the sun could be made to communicate to a good absorbent body, he would have placed the substance selected under circumstances more favourable to the accumulation of heat, and less favourable to its dispersion, than by merely enclosing it in a vacuum tube, and laying it on dry grass. Still, we may be sure that no contrivance which did not involve concentration of solar rays would have brought any substance near the ignition point of woody fibre, or similar material.

We sometimes notice in warehouse windows or skylight panes, cut, for cheapness, from the centre of sheet glass, with the protuberance and knob caused by the tube of the glass-blower. Such panes would act as imperfect burning-glasses, when the sun's rays fell upon them, and objects in or near their foci might be easily burnt in such weather as we have had.

The most inflammable substances in common use are, phosphorus,

in the form of matches, paraffin oils, benzoline, for the sponge lamps, and similar hydrocarbons. Now, the liquids in question—especially the benzoline—may be rendered highly dangerous in the hands of careless people, by raising them a few degrees above the ordinary heat; but they would not catch fire by exposure to solar rays. Bottles containing them might, however, be blown up.

We could not succeed in igniting benzoline with a stout piece of red-hot wire, though the experiment illustrated the so-called spheroidal state, when the wire was immersed in the fluid. At first little disturbance occurred, but as the wire cooled down, a strong ebullition ensued. The red-hot wire quickly vaporized the benzoline near it, and this vapour, being a bad conductor of heat, allowed the fluid to remain below its boiling point. As the wire got cooler, contact took place, and the ebullition began.

The way in which solar heat would render such substances as benzoline dangerous is by augmenting their evaporation, so as to increase the probability of their ignition by a light held near them. Young's paraffin is safe at all atmospheric temperatures, but hydrocarbons with very low boiling points, would be very apt to blow up in lamps used in hot summer weather, and they are not safe in winter temperatures.

Phosphorus, in the condition of lucifer matches, is the substance that requires most attention in hot weather, and, we believe, some inferior manufacturers still send out articles that cannot be considered safe. The safest match is that of Bryant and May, as the phosphorus is not in the match itself, but on the card, against which it is rubbed, and it occurs there in its least combustible form. In its normal state phosphorus, according to Miller, melts at about 111°·5, and readily catches fire in contact with the air, just above that temperature. "Solar heat" could easily make a blaze of phosphorus, were any in its way, on one of our model summer days. Possibly the above statement of the ignition point is too high. Brande observed in his "Manual," many years ago, that Dr. Higgins affirmed that perfectly dry phosphorus would take fire at 60°; but, whether this is strictly correct or not, lucifer matches made with common phosphorus are necessarily dangerous articles. They ignite with very little friction, and could not be considered safe if exposed to strong sunshine.

By careful heating, common phosphorus may be converted into red phosphorus, which is not poisonous, and much less combustible.

Miller says it may be heated in the open air till the temperature reaches 500°; at this point it melts and bursts into a flame. "Solar heat" would not, therefore, set the house on fire, with only a box of matches made of this substance to help it.

The German lucifers largely imported into this country, in round chip boxes, the matches having slender round sticks, are, we believe, made of red phosphorus. At any rate, the following experiments show them to be safe in solar heat. We dipped them in a mercury bath, heated to 210°, and they did not ignite. Next, we dipped others in a sand bath, which a thermometer showed to have, below its surface, a temperature of 215°. It was only by stirring the match about in the hot sand for a few seconds that we persuaded it to light. At a few degrees lower it took about half-a-minute's stirring to obtain ignition. We have not had an opportunity of experimenting with the sort of matches that were once common, and which ignited with the slightest friction. If such are still made, no sane person should buy them, as they cannot be safe to keep in any warm situation, and must be exceedingly dangerous if dropt where they are likely to be trod upon.

It is probable that many fires hastily ascribed to solar heat have resulted from the careless use of matches and fusees; indeed, pipes and fusees have been perilous neighbours all through the summer, and smokers may have offered up many sacrifices of farms and buildings to their favourite weed.

If the fields should be excessively dry in this month (September), or in October, sportsmen should be extremely cautious to avoid firing off combustible waddings from their guns. A careless smoker, or a shooter using paper wads, should be regarded as an incendiary and locked up.

The preceding remarks may have freed "solar heat" from some of the charges laid against it; and spontaneous combustion, though no doubt an occasional cause of fire, will not preserve its conflagration-making reputation if easy credulity is superseded by accurate research. We all know that there are substances which will ignite spontaneously. A solution of phosphorus in sulphide of carbon blazes up when poured upon the ground, and a damp hay-stack heats, smokes, and finally catches fire. A fire occasioned by the phosphorus solution, or any analogous substance, would not be accurately ascribed to spontaneous combustion, but to the design or gross carelessness of the person who placed such materials in a dangerous position. Hay-stack spontaneous firings may easily be

the result of accident, though the heating process gives timely warning to the watchful farmer. The rationale of such fires is simple enough. The damp hay, supplied with a limited quantity of air, ferments, absorbs oxygen, and passes from slow to quick combustion in a gradual way.

In warehouses and town buildings "spontaneous combustion" is usually referred to the coal-cellar, or to supposed accumulations of tow, rags, etc., saturated with oil. Certain coals are known as dangerous, and come very little into domestic use. If any fire is supposed to have been occasioned by such agency, we want proof that the pyritous coal was on the spot, and under conditions likely for ignition to have taken place.

In like manner, if a fire is conjectured to have occurred from heaping up greasy rags, or similar materials, and allowing them to oxydize, and finally proceed from slow combustion to quick, it ought to be shown that the facts of the case square with the theory. Oils, no doubt, absorb oxygen, and it is possible to get up a fire by availing ourselves of this property. But it is not very easy to do anything of the kind. A considerable mass of oil, with cotton or tow, in the right condition, is necessary. Oils vary in their capacity for absorbing oxygen. Brande tells us that "Saussure exposed nut oil for eight months to oxygen gas: at first the absorption was trifling, but in the course of ten days it had taken up sixty times its volume, and in three months 145 times its volume; the absorption being most rapid in warm weather."

Oils are technically divided into "drying" and "non-drying;" the former absorbing oxygen, and becoming solid. Miller ("Elements of Chemistry") states, that "the principal drying oils are linseed, walnut, hemp, poppy, cod-liver, and sperm;" and, he adds, "the absorption of oxygen by some of these oils, and consequent elevation of temperature, is, under favourable circumstances, so rapid, as to be attended with heat sufficient to cause the mass to take fire; and several serious conflagrations have been traced to the spontaneous ignition of cotton or tow soaked in linseed oil, which had been thrown aside in refuse heaps after it had been used in cleaning machinery." Statements of this kind form part of the stock material of text-books, and the writers rarely give the detail of actual cases. Now, before believing that any particular fire was occasioned in this way, we ought to have evidence that a sufficient quantity of cotton or tow, soaked in a drying oil, had been accumulated in a heap, free from a sufficient access of air to keep it cool.

If the supposed heap was in a room or cellar frequently visited, we should expect that a strong smell would be noticed by somebody before the fire broke out.

Miller says, "The most important of the oils which do not become dry by exposure to the air are olive oil, almond oil, rape oil, and colza oil, besides many animal oils. It is obvious that oils which readily absorb oxygen, and which become sticky by that process, are not the best adapted to grease machinery, and if a non-drying oil is used, spontaneous combustion is not likely to occur.

Fires are apt to be called "spontaneous," because their cause does not appear; but such a theory should never be accepted unless good ground for it can be made out.

ASTRONOMICAL NOTES FOR SEPTEMBER.

BY W. T. LYNN, B.A., F.R.A.S.

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Of the inferior planets, Mercury will not be favourably situated, setting, even at the end of the month, only about half an hour after the Sun. Venus will continue to be a splendid object in the early morning, being at her greatest elongation on the 26th, when she rises at 1h. 38m. A.M. Towards the end of the month she passes from the constellation Cancer into Leo.

Mars, which is in Gemini, will not rise, at the earliest, until nearly midnight throughout the month.

Jupiter rises on the first day at 7h. 41m., and on the last day at 5h. 40m. in the evening. He will be in conjunction with the Moon on the 4th. We again give a Table of those phenomena of his satellites which will be visible at convenient hours of the night. No eclipse of the fourth satellite will occur. The reappearances of the first, second, and third will not be visible after eclipse, the satellites being behind Jupiter at their emergence from his shadow. Their disappearances take place at a very short distance to the *left* of the planet, as seen in an inverting telescope.

DATE.	SATELLITE.	PHENOMENON.	MEAN TIME.
			h. m.
September 1 ...	I.........	Transit, ingress	10 40
„ 1 ...	I.........	Transit, egress	12 53
„ 2 ...	I.........	Occultation, reappearance......	10 1
„ 4 ...	III.........	Transit, egress	10 41
„ 6 ...	II.........	Transit, ingress	12 42
„ 8 ...	II.........	Occultation, reappearance......	10 2
„ 8 ...	I.........	Transit, ingress	12 24
„ 9 ...	I.........	Eclipse, disappearance	9 0
„ 9 ...	I.........	Occultation, reappearance......	11 46
„ 10 ...	I.........	Transit, egress	9 3
„ 11 ...	III.........	Transit, ingress	11 30
„ 15 ...	II.........	Eclipse, disappearance	9 0
„ 15 ...	II.........	Occultation, reappearance......	12 16
„ 16 ...	I.........	Eclipse, disappearance	10 55
„ 17 ...	I.........	Transit, ingress	8 34
„ 17 ...	I.........	Transit, egress	10 47
„ 18 ...	I.........	Occultation, reappearance......	7 56
„ 22 ...	II.........	Eclipse, disappearance	11 35
„ 23 ...	I.........	Eclipse, disappearance	12 49
„ 24 ...	II.........	Transit, egress	8 48
„ 24 ...	I.........	Transit, ingress	10 18
„ 24 ...	I.........	Transit, egress	12 31
„ 25 ...	I.........	Eclipse, disappearance	7 18
„ 25 ...	I.........	Occultation, reappearance ...	9 40
„ 29 ...	III.........	Eclipse, disappearance	7 9
„ 29 ...	III.........	Occultation, reappearance ...	10 1

SATURN will this month gradually cease to be a companion of the night. At its commencement, he sets at about half-past nine; at its end, as early as a quarter before eight. He continues near the bright star β Scorpii.

NEW PLANET.—The number of known bodies composing the group of minor planets between the orbits of Mars and Jupiter has now reached a hundred by the recent discovery of another new one on the 11th of July, by Professor Watson of Ann Arbor, U.S. The existence of the group is interesting, and, partly owing to its place (apparently filling up, in some measure, a gap) in the system, has led to some speculation, which has not, however, produced any definite result. The extreme minuteness of its members has

precluded their being of much utility to the physical astronomer. Nevertheless, some of them have aided, by the effects produced by his attraction, in confirming and improving our knowledge of the mass of Jupiter,* that powerful disturber of the motions of the other planets.

Occultations of Stars by the Moon.—We have to mention this month five of these phenomena, which occur before, or very soon after, midnight.

DATE.	STAR.	MAG.	DISAPPEARANCE.		REAPPEARANCE.	
			MEAN TIME.	V.	MEAN TIME.	V.
			h. m.	°	h. m.	°
Sept. 4	*f* Tauri	4	10 30	100	11 20	217
„ 8	71 Tauri	6	11 28	55	12 26	257
„ 27	42 Capricorni	6	8 50	172	9 24	226
„ 27	44 Capricorni	6	9 35	37	9 52	16
„ 28	58 Aquarii	6	10 16	105	11 35	325

We are reluctant to omit calling attention also to the occultation of the first-magnitude star Aldebaran, early on the morning of the 9th. The disappearance and reappearance will take place at two minutes before five, and fourteen minutes before six respectively, the angle V being at each 151° and 241°. The star will be very readily visible if the sky be clear, notwithstanding the daylight, which will be but partial at the disappearance, occurring, as it does, exactly half an hour before sunrise.

The Moon.—We have only space to mention her phases:—

September 2, 3h. 57m. A.M., Full Moon.
„ 9, 10h. 4m. P.M., Last Quarter.
„ 16, 1h. 20m. P.M., New Moon.
„ 23, 3h. 22m. P.M., First Quarter.

The Late Eclipse.—The late eclipse of the Sun, which was visible (if the weather permitted) in the East Indies, and some other of the tropical parts of the globe, on the 18th of August last, gives us occasion to dwell a little upon the many interesting circumstances which accompany these phenomena, that our readers may be fully aware of the present state of our knowledge regarding them,

* See a paper of my own, in "Monthly Notices of the Royal Astronomical Society," vol. xxvii. p. 1, where an account is given of a memoir on this subject, communicated by Krüger to the Finnish Society of Sciences.

and, therefore, the better able to appreciate the accounts of the total eclipse in question when they are received.

It is unnecessary here to speak of the value of eclipses in testing the accuracy of lunar tables, or verifying the dates and places of ancient historical events. The light that has in this way been thrown by the present Astronomer-Royal, Mr. Airy, upon several such occurrences, particularly that of the siege, by the Persians, of a Median city called Larissa, as recorded in the "Anabasis," is sufficiently known. At present we are concerned with the peculiar physical phenomena which have been seen to attend eclipses of the Sun, especially when total, and which, it is hoped, may in time lead to further discoveries concerning the constitution of the great orb of day. It was with a view to this that our Government, on the more than usually favourable occasion of the late total eclipse, sent out an expedition under the able superintendence of Major Tennant (who was aided in his equipment by the Royal Astronomical Society), and the Royal Society also deputed Lieutenant (son of Sir John) Herschel, to make observations at a somewhat different locality, so as to diminish the chances of failure from a cloudy sky. Both the French and Germans have also sent out expeditions for the same purpose, and every effort has, doubtless, been made to render this eclipse as useful to the progress of science as nature may have permitted. We shall hope, next month, to be able to report some of the conclusions arrived at. In the meantime we will briefly allude to the special phenomena which have been noticed on former similar occasions. The principal of these are the corona and the rose-coloured flames, or protuberances. When the Sun is totally eclipsed, the black disc of the Moon is seen to be surrounded by a corona or "glory" of light, which appears to vary constantly in brightness, and to have frequent coruscations darting from the Moon's edge. On this, and closely surrounding the Moon, are seen, as it were, flames or clouds of various tints of red, and of great brilliancy. The celebrated expedition in the "Himalaya" to observe the eclipse which was total in Spain in the year 1860, decided the question, previously considered doubtful, that these flames, or *prominences* (as they are now generally called) belong to the Sun, but much was still left to be learned. In the words of Major Tennant, "As to the corona, we do not know whether it is the heated, and therefore luminous atmosphere of the Sun, or if it be merely a phenomenon of our own atmosphere. As to the prominences, it is certain that they belong to the Sun, but what they are we do not know. They must be huge—far larger than any of the planets, and

having a volume which is a sensible fraction of that of the Sun. But what are they? Do they shine by their own light? And if so, what is the substance from which that light proceeds? Or do they owe their brilliancy, which exceeds that of the Moon at full, to their power of reflecting the light of the Sun?" As in so many other points of interest, the new engine of astronomical research will, doubtless, have been advantageously employed in these inquiries, and may lead us to satisfactory answers to some of the above questions. The astronomers who have gone to India have not failed to provide themselves with the means of making all practicable application of it. Of course we allude to the spectroscope.

We shall perhaps most usefully call attention to the matters of interest concerning which we may hope that some new instructive and suggestive facts have been detected at the late eclipse, by referring to previous accounts of total eclipses, and also to a remarkable one of an eclipse which was annular last year in Dalmatia.

The first that we propose to recall to our readers' recollection is that which occurred in Sweden and Norway in the year 1851, on the 28th of July, and to observe which the Astronomer-Royal headed a party sent to those countries, at his desire, by our Government, for that purpose. Mr. Airy selected as his own station a central position at Göttenburg, a place easy of access, and celebrated for the first observation, by Vassenius, of the red prominences visible in a total eclipse; and it will be sufficient to abstract the most noteworthy of his remarks from the Memoirs of the Royal Astronomical Society.*—Immediately the totality took place, he removed the dark glass from the telescope, and at once saw the corona and prominences. The former was far broader than that which he had seen on a similar occasion in Italy, in 1842, its breadth being now little less than the Moon's diameter, though in outline very irregular. In colour it was white, and its appearance was that of a radiating luminous cloud behind the Moon. The form of the prominences was most remarkable. The largest was shaped like a boomerang; the colour for at least two-thirds of its breadth was a full lake-red, whilst the rest was nearly white, the most brilliant part being the swell furthest from the Moon's limb. A second prominence was like a pale white semicircle, based on the Moon's limb; and a third, red in colour, was quite detached from the limb, being separated from it by a space (differing in no way from the rest of the corona) of nearly its own breadth. All these were within a small distance of each other; but on the opposite side of the Moon was seen a

* Vol. xxi., p. 5, etc.

fourth, resembling a small triangular or conical red mountain, perhaps a little white in the interior. During the progress of the totality changes occurred; the three near together were thought to have increased in height, whilst a new one rose up, and the one on the opposite side of the Moon disappeared. All the changes irresistibly led Mr. Airy to the "conviction that the prominences belonged to the Sun, and not to the Moon." When the totality ceased, they all, as well as the corona, vanished from sight.

The history of the eclipse seen total in Spain in 1860, on the 18th of July, will be in the recollection of most of our readers; as will be also the good service done on that occasion by photography in the hands of Mr. De La Rue, in establishing beyond doubt the fact of the fixity of the flames or prominences relatively to the Sun, whilst they are covered and uncovered during her motion by the Moon. Some very interesting observations were made of that eclipse by Dr. Bruhns at Tarazona. A protuberance was seen by him through a light red glass about one minute before the totality commenced, and was kept in view until more than six minutes after it had ceased. But immediately the totality occurred, the corona, a part of which had been seen before, burst forth in such intense white light as to obscure the brilliancy of the prominences, several of which were now seen. A very remarkable one, which appeared to edge the Moon's disc for a considerable length like a seam, was gradually seen to be covered by it, as was also another one of smaller size, which was at first completely separated from the limb. They were of rosy-red colour. Several others were noticed, but all disappeared at the termination of the totality, with the exception of the one first seen, which, as before mentioned, was followed (through the light red glass) for six minutes afterwards. "If the protuberances," says Dr. Bruhns, "are parts of the Sun, perhaps a kind of cloud, for they have been seen, as it were, freely suspended, it follows, according to our ideas, that an atmosphere must exist in which they float, and the corona may then be, in fact, that atmosphere."*

We must refer, also, to Mr. Airy's observations during this eclipse concerning the visibility of the prominences before the totality. "When," he says,† "from the narrowness of the Sun's lune, I judged that the totality would occur in ten or fifteen seconds, I withdrew the graduated coloured glass. To my infinite astonishment, while the white Sun was still shining brilliantly, I saw in great splendour two red prominences (possibly more than two were visible), and one

* "Astronomische Nachrichten," vol. liv., p. 317.

† "Monthly Notices of the Royal Astronomical Society," vol. xxi., p. 9.

double red floating cloud. But before the white disc had disappeared, the white corona formed round the Moon, I think all at once; and the Moon was seen complete, with dazzling sun, brilliant corona, and brilliant prominences. The intensity of light in the corona and prominences was not much increased at the total disappearance of the Sun."

But the long visibility of the red prominences which was observed during the eclipse, which was not total, but annular, in Dalmatia, on the 6th of March last year (1867), was so remarkable that we have thought it desirable to refer to it at some length, as reported by Dr. Weiss, who directed the operations undertaken on that occasion, to the Vienna Academy. The observations in question were made by Ship's-Ensign Kiha, of the Austrian Navy. No complete account of them has, so far as we are aware, yet appeared in English, and we therefore furnish our readers with the following translation of the most interesting parts of Dr. Weiss's memoir. It will be seen how carefully he has applied every test which was possible as to the accuracy of the observations.

"Passing on to the other phenomena observed, I will first devote a few words to the faint light within the Moon, which was also seen in this eclipse. All three observers mention it. Cadet Kunwald, who, about the time of the greatest phase, saw the Moon's limb much more lightly shaded, and still more definitely marked; Cadet R. von Goertz, and Ship's-Ensign Kiha. The latter, moreover, noticed this internal luminosity most distinctly in the region of the protuberance (or, as this was very near the Sun's cusp, in the region of that cusp). This phenomenon is of a purely subjective nature, as the investigations of Airy* and Challis† on Professor Stephen Alexander's photographs of the eclipse of 1860, July 18 (which showed precisely the same appearance on the cusps, including the apparently greater brightness of the luminosity), have proved.

"The formation of beads at the beginning of the annularity, of which Cadet R. von Goertz speaks, possesses, for this reason, a somewhat greater interest than usual, namely, that in this case it may be asserted, with tolerable certainty, that it depends upon the unevennesses of the Moon's limb; for the libration must have had such an influence, that, during the eclipse, unusually high mountains came upon the limb, inasmuch as not only were they noticed as strikingly conspicuous by Ensign Kiha, and even by Cadet Kun-

* "Monthly Notices of the Royal Astronomical Society," vol. xxiv., pp. 13 and 188.
† Ibid., vol. xxv., p. 13.

wald with his small telescope, but also the reports of several astronomers on the observation of this eclipse, which I have since seen, speak of them expressly. Now, as R. von Goertz found himself very close on the limit of annularity (the duration of which barely amounted to four seconds), and the Sun's annulus was therefore, in the narrowest place, scarcely 1″ in breadth, it is not to be doubted that certain mountains in the Moon projected over the Sun's limb, and must thereby have separated the annulus of light into a long string of beads, which appeared also to the observer himself to be the cause of the phenomenon.

"It is further worthy of remark, that Ensign Kiha perceived, immediately after the beginning of the eclipse, traces of the corona where the dark limb of the Moon overpassed the Sun's disc. He succeeded afterwards in detecting distinct indications of it (with the armed eye indeed only) fifteen minutes, and even twenty-eight minutes, after the middle of the eclipse, in the yellowish light which surrounded the Moon's limb, far on the side opposite to the Sun's crescent. So long a visibility of the limb has never yet, if I mistake not, been observed, and must indeed be ascribed entirely to a very great clearness and transparency of the air, such as sometimes occurs when a partial clear-up takes place on a rainy day.

"By far the most interesting and important observations, however, made during the eclipse, were those of the prominences, by Ensign Kiha. As early as 10h. 37m. 50s. chronometer-time, and, therefore, 14·4m. before the beginning of the formation of the annulus, he perceived one prominence in the neighbourhood of the Sun's upper horn; and, after an interruption of nearly half an hour, he again saw one through clouds from 11h. 5m. to 11h. 6m. 58s., or from 12·8m. to 14·7m. after the middle of the eclipse, on the Sun's upper horn; which he thought was not the same with that previously seen, but which, as we shall immediately show, was really identical with it.

"This extraordinarily long visibility of a prominence is so different from all our previous experiences in other eclipses, and is at the same time a fact of so great importance, that it will be worth while to subject this observation to an accurate discussion.

"In the first place I have, for the times at which Ensign Kiha made his drawings, calculated the appearance of the eclipse, in order to be able to test the degree of their accuracy. In doing so, I have assumed the latitude of Barsecinne to be 3′·0 more southerly than it is given above, that is, I have made the calculations with the latitude 42° 40′·7, instead of 42° 43′·7, because this method

appeared the simplest for taking into account with sufficient accuracy the circumstance indicated by the observations, that the boundary of the annularity was situated 3′·0 more northerly than resulted from calculation.

"Reckoning, as usual, the angles of position from the north point through east to south, we find:—

	CHRONOMETER-TIME. 10h. 37m. 50s.	11h. 5m. 0s.
"Distance between the centres of the Sun and Moon . .	294″·2	282″·6
"Angle of position of the Moon's centre compared with the Sun's centre, referred to the horizon	262″·9	84°·0
"Angle between the vertical circle and the declination-circle	—21°·0	—14°·9

"With these data, and assuming the semidiameters of the Sun and Moon at 969″·0 and 948″·3, I have constructed for both times the position and breadth of the Sun's crescent, to compare with Kiha's drawings. The agreement of the two is surprisingly good.

"As, according to the arrangements which had been made (which are more clearly explained in the instructions for observations with the telescope), Ensign Kiha had obtained the position and magnitude of the Sun's crescent, by fixing a disc of the Moon upon one of the Sun, their diameters being drawn in correct proportion to each other, it was possible to go a step farther, and to take from his drawing the angle of position of the prominences compared with the centres of the Sun and Moon. Denoting that first seen by P_1, the other by P_2, we find by measurement:—

"Position-angle referred to the horizon,	for P_1;	for P_2.
compared with the Sun's centre	171° ...	170°
,, Moon's centre . . .	161 ...	182

"If we refer the angles of position, by applying the parallactic angle previously given, to the equator instead of the horizon, we obtain:—

"Position-angle compared with the Sun's centre, referred to the equator, for P_1, = 150°
,, P_2, = 155

Mean = 152·5

"Position-angle compared with the Moon's centre, referred to the equator, for P_1, = 140°
„ P_2, = 166

"The agreement of the angles of position of the two prominences referred to the Sun's centre is, for eye-estimations, so excellent, that no doubt can exist as to the identity of the two, or the adherence of this one prominence to the body of the Sun. Referred to the Moon's centre, on the other hand, the angles of position differ very considerably, and this can so much the less be ascribed to an error in the drawing,* as the prominence, if connected with any one point of the Moon's surface, could not have changed its position, simultaneously with the Sun's crescent, from right to left, as was, in fact, the case according to the drawing. The latter circumstance, together with the fact of a prominence being seen now, for the first time, immediately upon the Sun's crescent itself, appears to me to furnish a convincing proof that the phenomenon is not of an optical nature.

"The single circumstance which seems to militate against the identity of the two prominences, is their difference of colour. For the first, seen through a light blue glass, appeared of a pale-rose colour; the second, seen with the naked eye, of a brownish yellow. This contradiction, however, is only apparent, for if the image of the latter prominence be viewed through the glass used by Kiha, it acquires an unmistakeable pale-reddish colour, so that the circumstance in question, far from proving the non-identity of the two prominences, is in fact a new confirmation of the fidelity and care with which the observations were made.

"Before I add any further remarks on this subject, I will devote a few words to another point noticed by Kiha, because it might easily be regarded as optical, which, in my opinion, it is not. He mentions that the points of the cusp appeared to him, about 11h. 5m., to be reddish, and that this colour gradually faded away towards the broader parts of the crescent. The cause of this phenomenon I should seek in those proportions of luminosity of the Sun's surface, which become apparent in a projection of the Sun's image. It is well known that a projected image of the Sun appears

* As a last check, I have also calculated, on the assumption of an angle of position of the protuberence of 152°·5 referred to the Sun's centre, the corresponding angles of position compared with the Moon's centre, and found as such—

For P_1.................... 136°
„ P_2.................... 169

harmonizing very well with the direct measures.

much brighter in the middle than at the edges, and, moreover, the colour assumes, in the neighbourhood of the latter, a brownish-red tint. Now, so long as the crescent continues very small, this brownish-red colour will show itself very distinctly on the narrow points of the cusps; but it will be lost in the broader parts of the crescent, for the same reason that in a direct eye view of the Sun nothing is seen of the diminution of brightness, and the change of colour towards the limb.

"It has thus been shown that Ensign Kiha saw one and the same prominence through an interval of more than 29 minutes, from 10h. 37m. 50s. to 11h. 6m. 58s., subject to interruption from passing clouds. It also deserves to be particularly mentioned, that he saw them in the uncovered part of the Sun's disc. These two facts are unique in their nature as observations, and are of unmistakeable significance, in that they throw an entirely new light upon the visibility of these images. For the magnitude of the eclipse was, according to the usual scale of estimation, only 10·1 digits, when Ensign Kiha first perceived the prominence, and had again decreased to ten digits when he saw it last. Moreover, it must also be remarked that it then disappeared, on account, not of faintness of light, but of intervening clouds, and also that at its first appearance it must have been a rather striking object, as it was also seen by his companions, one of whom saw it through only a good opera-glass. We learn, therefore, from these observations, that the visibility of the prominences is not confined to the zone of totality and annularity, or their immediate neighbourhood, but sometimes extends, under favourable circumstances, to large partial eclipses; since the prominence noticed, for example, at Barsecinne might have been seen upon the whole terrestrial zone between Prague and Athens.

"In looking for prominences during the greatest phase of considerable partial solar eclipses, the regions in the neighbourhood of the points of the cusps are, of course, the only ones in which we can reckon on being successful; it will, therefore, be very advantageous to turn the other parts of the Sun's crescent as much as is practicable out of the field of view of the telescope, in order to make the observations with the lightest possible coloured glasses. It is further advisable to make use in succession of differently-coloured glasses, because the prominences vary considerably in colour, and will, therefore, stand out better from the background, if viewed sometimes with one, sometimes with another glass. But in general blue glasses serve best for the purpose.

"The observation of Ensign Kiha merits special consideration

also in another respect. It has long been considered as proved, and the observations of this eclipse have afforded a new confirmation of it, that the prominences are formations connected with the body of the Sun. But we know absolutely nothing further concerning their nature or their connection with the different formations upon the Sun's surface,* and we shall long continue in such ignorance unless we can succeed in seeing prominences on other occasions besides solar eclipses, and such as take place more frequently. As such, Director von Littrow has already, some years ago, indicated the rising and setting Suns in the more southern seas (for example, the Adriatic), but the idea seems to have been but rarely regarded, probably because the visibility of prominences at such opportunities was doubted. But Kiha's observation shows that large prominences may be visible at sunrise and sunset, and the same also appears to follow from an observation of Tacchini at Livorno during the sunset of the 8th of August, 1865.† It would, therefore, be very desirable that these observations should induce dwellers on the coast carefully to weigh the idea, and to watch systematically for prominences at clear sunrises and sunsets over the sea."

STEIN ON THE MUSCLES AND CILIA OF INFUSORIA.

The following is a condensed translation of the remarks made by Stein in the recently published second part of his work, "Der Organismus der Infusionsthiere," from which we have previously made extracts :—

"One point of my former definition has to be rectified. I had considered that the Infusoria had no muscles, considering their existence would indicate a nervous system, of which I could find no trace. The works of Kühne have now proved that an independent irritability exists in the muscles, and that their contractile power does not depend upon the action of nerves. We may, therefore, credit the Infusoria with muscles, since these can exist without the presence of nerves."

* The opinion has frequently been expressed that the prominences have a certain connection with the faculæ and spots of the Sun. It seems to militate against this, that great prominences have often been seen in regions of the Sun, in which faculæ and spots only exceptionally make their appearance. This is shown by a glance at the drawings of the eclipse of 1860 by De La Rue, and other observers; as, in them, prominences occur along the whole periphery of the Sun. In this eclipse also Kiha's prominence was situated near the south pole of the Sun.

† "Bulletino Meteorologico dell' osservatorio del Collegio Romano," vol. iv., p. 92.

Kühne has demonstrated, in his experiments on the irritability of the muscles, and their existence in the lowest organisms of animals, that the electric current produced by the induction apparatus is one of the most direct agents for the excitation of the muscles; without any assistance of motor nerves they can produce an action amounting even to tetanic contractions. Hydrochloric and nitric acids, much diluted, are also powerful agents, as well as ammonia. A mineral acid, a hundred times diluted, and even still further attenuated by water, which becomes powerless to act upon the intermuscular nerves (as a strong concentrated acid of 19 to 20 per cent. will do) produces strong convulsive movements on the muscles. The same result is produced by ammonia, the fumes of which will, at some distance, convulse the muscles, although ammonia has no action on the nerves. Certain poisons also, as the sulpho-cyanide of potash, veratrin, and the celebrated arrow poison (wourali ?) have an immediate effect upon the contractile substance of the muscles; they do not only cause convulsive movement, but create a strong contraction in the muscles; they make them stiff and hard, and cause them to lose their excitability, or, in other words, to become dead. Those poisons must, therefore, be specified as muscle poisons.

If the muscles of cold-blooded animals are heated to a temperature of 40° C., the "warmth-rigidity" (wärmestarre), a condition very similar to death-stiffness, is superinduced. The cause of the death-stiffness and warmth-stiffness, is in the fact that certain fluid ingredients of the contractile substance of the muscles become coagulated.

Kühne has made use of these direct agents to show how far real muscles exist in the lowest animals. The elements of the voluntary muscles, the ultimate fibres, consist of a structureless, glassy, elastic integument, the *Sarcolemma*, and of the proper contractile substance, closely surrounded by this integument, and marked by cross stripes and longitudinal stripes. According to Kühne, the contractile substance of the ultimate fibre is a fluid mass, which, at the approach of the death-stiffness, becomes hard, full of the small regularly-constituted corpuscules, which cause the transverse and longitudinal striations. This fluid mass can move in all directions, so that the ultimate fibre augments as much in breadth as it is shortened in length. It is just the same with the sarcode, only that the small corpuscules contained in it are irregularly disposed—even the movements of an Amœba seem to be the complete analogue of the movement of the ultimate fibre of muscles.

Electricity was found to have little effect upon numerous Amœbæ. They continued their ordinary motions under the action of the strongest induction-shocks. Similarly powerless are the diluted mineral acids, and the sulpho-cyanide of potassium, which, much diluted, produces the death-stiffness in muscles. A moderate heating also kills the Amœbæ, and they harden into a globular brownish mass. This heating need not reach 40° C., as with muscles, but operates between 34° and 35° C.

Experiments show the same effect in the marine variety of *Actinophrys sol.*

Quite otherwise are the Infusoria, at least, the superior kinds. If induction-currents passed through the fluids contained in such Infusoria as *Stylonichia mytilus*, *Euplotes patella*, *Paramecium*, *Amphileptus fasciola*, and *Opalina ranarum*, violent movements appear in these animals, and disruption takes place, and finally the currents exercise no influence whatever on the ciliary action.

With moderate currents sometimes it happens that, after the first violent shock, the animals remain still, or in a sort of tetanus; after repeated shocks of stronger currents they dissolve into a formless pulp, though still here and there the ciliary movement continues. The simplest monad-kind of Infusoria and the Vibriones remained quite insensitive to the strongest induction shocks.

Kühne made the most comprehensive experiments with Vorticellæ, and especially, indeed, with that kind which adheres to the roots of the duck-weed, probably *Vorticella nebulifera.* He put on the object-glass a piece of the above-named root, to which numerous Vorticellæ were adhering, and, enclosing it with a drop of water, he directed induction-shocks through the water, and found that the Vorticellæ suddenly contracted towards the point of adhesion. When the irritation of the induction-shocks ceased, the animals unrolled themselves slowly, the body took its usual form, and the whirlpool ciliary movement commenced anew. After continuous strong induction-shocks, the Vorticellæ died, the body was disrupted, and melted gradually away, leaving the screw-like stem unchanged.

But the most important and instructive experiment of electric irritation is that tried by Kühne on the stem of the Vorticella, directly after separation from the body; he found that it contracted on the application of induction-shocks. This experiment clearly shows that it contains a real muscle. The best proof of the muscular nature of the stem was furnished by heating the Vorticellæ. They remained, at 38° and 39° C., not only alive, but were even

unusually brisk. As soon, however, as the temperature reached 40° C., they became suddenly rigid, and their closely rolled up stalks showed the interior muscle clearly.

From these experiments Kühne comes to the conclusion that the movements of the sarcode, and the ciliary movements, are to be regarded as distinct from the real muscular movements; and he believes that there can remain no doubt as to the real muscular nature of the stalk of the Vorticellæ.

Stein adheres so far to Kühne's opinion concerning the distinction between the muscular movement and the movement of the sarcode, but supposes that the first represents only a modified form of the latter; as he believes that, from a morphological point of view, the muscles of the Infusoria are to be considered as nothing but stripes formed from masses of sarcode. With the exception of the muscle of the stalk of the Vorticellæ, Kühne has only proved the great probability of the existence of a real muscular substance in the higher forms of the Infusoria. Stein goes further, and tries to demonstrate which is real muscular substance and which is sarcode. If it is taken for granted that the longitudinal and spiral stripes of the Stentors are real muscles, it has also to be considered as evident that the sharply defined stripes on the surface of the other Infusoria, provided with cilia, are systems of muscle-fibres, by means of which the body contracts. After experiments with numerous kinds of Infusoria, Stein comes to the conclusion that the stripes, wherever they appear, are to be considered as the first beginning of a muscular system. The stripes appear more or less in a spiral form, and this arrangement may be best seen on any large specimen of *Spirostomum ambiguum,* and still clearer if the specimen is viewed in the act of contraction, and when it begins gradually to stretch itself again.

When we inquire after the signification of the body-stripes, it becomes clear that their only object is to regulate the contractions of the body, and this appears conclusive from the fact that the contractions of the body ensue always in the direction of the stripes. *Spirostomum ambiguum* furnishes the best proof of this assertion.

With regard to the intimate structure of muscle-fibres and the body-stripes, Stein inclines to Brücke's opinion, that the contractile substance of the muscle-fibres consists of a homogenous viscid fluid mass, containing very fine granules possessing a refractive power, and its cross and longitudinal striations proceeds from the different grouping of the granules.

Stein coincides with Schulze in considering the body-stripes of

the Infusoria as an imperfect form of the muscle-fibres. They are probably the most primitive form of the muscle-fibre, and also the highest development of sarcode.

After we have credited the Infusoria with a kind of muscular system, it will be necessary to add some remarks concerning the motory organs. The cilia are the real limbs of the Infusoria, and are not only used for locomotion, swimming, running, climbing, rowing, and leaping, but they also carry the food to their mouths, and are further used as feelers. By watching any specimen of the Infusoria, we can convince ourselves easily that the cilia are not in continual motion. Sometimes they remain quite still, and at other times the mouth-cilia, and also the body-cilia, move in more or less rapid vibrations.

The mouth-cilia do not allow all bodies without distinction to pass down the throat, but thrust a great many far away, after a careful examination. The exterior body-cilia of the Infusoria are likewise subject to the will of the animal, and it is manifest that they represent the legs and antennæ of creatures of a higher organization. In his first volume, Stein treated the cilia as simple outgrowths of the cuticle; but this he now acknowledges to be an error, having had the opportunity of observing different kinds of Infusoria during their moulting-process, and thus convincing himself of the fact that the cilia are in immediate connection with the outer sarcodic layer. This last assertion deserves still more credit, when we regard the fact that the cilia are entirely under the control of the animal's will, and that they are sensible to external impressions. After numerous experiments with the discarded skins of different kinds of Infusoria, Stein could find no trace of structures of a cellular system; and concluded, therefore, that the cuticle is nothing more than amorphous jelly-like secretion of the sarcode, nearly related to the tube formations in which a great many Infusoria pass their whole lives. It is clear, therefore, that the cilia grow from the outer sarcodic layer, and not from the cuticle; and this receives additional strength through observations which may frequently be made of the phenomenon of diffluence, and the resolution of the cilia into a bundle of fine fibres, which shows that the cilia consists of a different substance from the cuticle. On the so-called mailed Infusoria, the cuticle arrives at its greatest thickness; but then it passes over so gradually into the sarcode, that an interior line of division cannot easily be drawn with correctness.

Stripes originating in a kind of musculo-fibrous element never occur in the mailed Infusoria.

ARTERIAL CAPILLARIES IN INSECTS.

BY JULES KÜNCKEL.

(Translated from "Comptes Rendus.")

ZOOLOGISTS thought that all the circulation of blood in insects was confined to the currents seen by Carus, in transparent larvæ; but in 1847, M. Blanchard adduced proofs that the tracheæ of these animals fulfil the function of arteries, in carrying, in a peripheral space, the nutrient fluid to all the organs. By means of delicate injections, he recognized the existence of a free space between the membranes constituting the tracheal tubes, and his injected liquid drove out the blood and replaced it.

After having verified and confirmed the discovery of M. Blanchard, M. Agassiz insisted on the conclusiveness of the demonstration. Endeavouring to complete the discovery, he paid particular attention to the termination of the tracheæ. In a memoir published in 1849,* this observer distinguished two sorts of tracheæ, one terminating in small enlargements, and the other in slender tubes destitute of a spiral filament, and which he named "capillaries of the tracheæ." He thus expresses himself, "I injected the dorsal vessel of grasshoppers, and found the muscles of the feet elegantly covered with the arborescent tufts of these vessels, all injected with the colouring matter, and in a portion of muscle of *Acridium flavo-vittatum*, highly magnified, I noticed the distribution of these little vessels, which bears a strong resemblance to that of the blood vessels of the inferior animals."

Nearly twenty years have elapsed since M. Agassiz announced these facts, which appears to have been little noticed, as they are not mentioned by writers on the anatomy and physiology of insects.

A direct observation of the circulatory phenomena was wanted; no one had witnessed the movement of the blood in the peritracheal space, or in the capillaries, and M. Milne Edwards pointed out as a fact to be regretted, that the existence of currents in the tubiform lacunæ was not established.

Led by general researches into the organization of the diptera, to make a special study of the circulatory and respiratory apparatus, I frequently examined the tracheæ, and I saw without difficulty the globules between their two coats, but they were motionless when the animal was dead. Continuing my study of the distribution of tracheæ in the muscles, I was too much struck with their character to neglect it. Having succeeded in removing from one of the

* "Proc. Amer. Assoc. Scien.," 1849, p. 140—3.

Syrphides, while alive, a muscular bundle without tearing it, and having placed it quickly in the focus of a powerful microscope, I was suprised to see the blood confined between the tracheal membranes run through the peritracheal space and penetrate the finest arteries. I saw the course of the blood globules as easily as it can be seen in the capillaries of the mesentery, or in the membranes of the frog's foot.

I have been able to convince myself of the existence of a system of capillary arteries in all insects; the most slender of these vessels not only traverse the muscles, but likewise the different organs. Generally, the blood seen by transparent illumination, exhibited a rosy tint, very favourable for observation. When the blood leaves the tracheæ, and the capillary arteries, I have often noticed that they lose their colour. The tracheæ can always be recognized by their spiral threads, but it is very troublesome to distinguish the capillaries on account of the thinness and transparency of their walls.

The difficulties of the experiment are great. The insect must be opened quickly, a muscular bundle removed from the living animal and placed under the microscope, and then, if circumstances are favourable, the blood may be seen rapidly traversing the capillaries. For these researches a considerable magnification is requisite.

The tracheæ, as is known, are composed of two coats, the internal coat forms the envelope of the air channel, the external coat, or peritracheal membrane (peritoneal membrane of the Germans), surrounds the former, and leaves a peritracheal space. But at the point where the tracheæ penetrate the muscular fibres, the internal coat disappears, the aërial canal terminates in a cœcum, while the external coat, or peritracheal membrane, becomes the wall of the capillary arteries. It is not only the spiral thread which disappears, the internal coat itself ceases, and abruptly closes the air canal. From a tolerably large tracheal trunk, a greater or less number of very slender capillaries proceed, regularly dividing and sub-dividing at their extremities.

The blood contained in the peritracheal space is in contact with oxygen throughout its course, and reaches the capillaries completely vivified. It is true arterial blood. The capillary arteries are not in communication with capillary veins, the blood escapes into the tissues, nourishes them, and falls into the lacunæ, the lacunary currents taking it back to the dorsal vessel.

In fine, the tracheæ of insects are air tubes in their central portions, blood vessels in their peripheral spaces, and true capillary arteries in their terminations.

ARCHÆOLOGIA.

A VERY interesting ROMAN SEPULCRAL MONUMENT was discovered at Ilkley, in Yorkshire, in the month of October last, of which, by the kindness of a correspondent, we are enabled to give the accompanying cut, from a photograph. Ilkley, situated near the river Wharf, high up in Wharfdale, is generally considered to be the *Olicana* of the Romans, and is remarkable for the number of Roman antiquities which have been found in it. The one here represented furnishes a very curious illustration of the chapter of "Womankind" in the second number of THE STUDENT. It is a sepulchral monument, commemorating a Romano-British family of Olicana, but the inscription on the tablet below the sculpture, which no doubt gave us the names of the individual and of his wife and son, figured above it, has unfortunately been entirely erased. The lady's head-dress points to the age of Severus, or a little later, as the date at which this family lived. She wears a necklace of pendants, and holds in her right hand a little basket of fruit, or flowers, but the object she has in her left hand is so much worn that it cannot easily be defined. The boy holds a box and a wreath. It is worthy of notice that, among the inscriptions found at Ilkley, there was one commemorating the rebuilding of some public building here by Virius Lupus, who was pro-prætor of Britain in the reign of Severus. A cohort of the Lingones appears to have been stationed here, and among the other monuments dug up at different times was a Roman altar dedicated by a centurion of that cohort to the goddess Verbeia, supposed to have been the river goddess of the Wharf.

An extensive discovery of ROMAN REMAINS has been recently made at Stonham in Suffolk. A valley runs through the two parishes of Earl's Stonham and Stonham Little, the southern part of which appears to have been the site of an extensive cemetery, and many sepulchral urns and other objects have been found there. As is the case in many other places, the later parish church was built upon, or close to, the cemetery; with the object, no doubt, of attracting to it the population of the district, who long looked with reverence upon the ancient burial places. In the other part of the valley great quantities of pottery, iron, lead, glass, querns, flue-tiles, coins, and other objects, were found, indicating the existence of a settlement of some kind, and it has been suggested that this may be the

true site of the Roman *Sitomagus*. Among the remains found here were many flint implements, such as celts, arrow-heads, spear-heads, scrapers, etc.; and among other objects gathered from this spot were an abundance of horns and bones of animals, of which we may mention the horn-core of the goat, the metatarsus of the deer, the truncated fork of a fine antler of the *Cervus elephas*, a pointed bone which appeared to have been used as a tool, and shells of the common oyster, the whelk, and the *Natica castanea*. The coins found here were chiefly third brass of the *lower empire*, mostly in a bad state of preservation, but those which could be read were of Claudius Gothicus, Diocletian, Carausius, *reverse* PAX, Constantine I. and II., Magnentius, and Valens. There was also found among them one of the late coins, called by numismatists *minimi*.

The last number of the "Reliquary" contains accounts of an ANGLO-SAXON CEMETERY at KING'S NEWTON in Derbyshire, brought to light by the excavations for a new line of railway. A number of burial urns were found, containing burnt human bones, and many of them interesting for their forms and ornamentation. They have been formed by hand, not on the wheel, and are usually of a dark coloured clay, sometimes nearly black, and at other times of a dark brown. The ornaments usually consist of encircling incised lines in bands or otherwise, and verticle or zigzag lines arranged in a variety of ways, and, not unfrequently, knobs and protuberances. Sometimes also they present evident attempts at imitation of the Roman egg-and-tongue ornament. A marked feature of the pottery is the introduction of small impressed ornaments, evidently produced by the end of a stick cut and notched across in different directions. This cemetery belonged to the people of Mercia, who were Angles by race, and the Angles, as we know, differed from the Saxons in the practice of burning their dead, instead of burying the body entire. King's Newton is only a few miles from Kingston, where an extensive cemetery of the same people was found in 1844, and at no great distance from Repton, where was the capital of the Mercian kingdom. T. W.

PROGRESS OF INVENTION.

UMBRELLAS AND PARASOLS.—Umbrellas have hitherto been made of materials which absorb moisture, and, when thoroughly wetted, serve but as an inefficient protection against rain. The water, moreover, which saturates them, tends to cause their destruction, unless they be carefully dried before being rolled up. Mr. Charles Connor, of Old Ford, has patented an application of a very useful material for the construction of umbrellas, which, it seems strange, has never before been used for this purpose. He attaches to the ordinary framework of umbrellas and parasols, waterproof fabrics, woven, fulled, felted, looped, or knitted,

such as cambric, linen, cloth, silk, or any other textile fabric, and these he coats on one or both surfaces, with vulcanized caoutchouc or with gutta-percha, or any other similar gum, resin, or compound of such substances, so as to render them waterproof. He applies the caoutchouc by any of the methods at present in use for that purpose, as, for example, by rolling or pressing, or by spreading with or without a solvent. The fabric, when waterproofed, is cut into intercostal sections, so as to extend between the ribs of the umbrella; the edges of the sections are then scraped and connected together by means of a solution of the waterproofing material. To avoid the necessity of perforating the covering, he attaches it to the frame of the umbrella or parasol by cementing to the material stays, strips, or extra pieces, which are made of the same fabric as the covering, and these he tacks or otherwise fixes to the frame. The vulcanized india-rubber is not softened, or in any way affected by heat; and the complete protection which it affords against rain, together with its impenetrability, and the ease with which it is freed from moisture, will doubtless render his invention of great use, and secure its very general adoption.

COLLARS, CUFFS, ETC.—Paper collars are very convenient, but the mixture of linen and paper is better; still in hot weather such collars break down, and with people who perspire freely, soon become little better than a rope about their necks. Enamelled steel has been tried, but its appearance was against it, to say nothing of the evident danger to the wearer of cutaneous abrasions, if of nothing worse. Messrs. John Blakey and Howard Busby Fox, have invented a method of making collars, which is applicable to cuffs, anklets, belts, and other like articles of wearing apparel, which are more or less exposed to view when worn on the person. The collar is made in two parts, the one consists of a frame, or holder, made of leather, caoutchouc, silk, or other woven fabric, which, while it is of a durable and ornamental character, is also of such a design, and coloured in such a manner, that it will retain its freshness of appearance for a considerable length of time. The other part consists of a slip or leaf, or slips or leaves of paper, calico or other material of such form and size that it, or they, can be easily fitted into, and removed from, the frame from time to time. The articles made according to this invention, are described by the inventors, in their specification, as being like framed pictures, of which the frames are flexible, so as to allow of the insertion of the calico or paper (which is really the representation of the picture) and of its removal when desired.

KNIFE CLEANER.—Messrs. Obediah Barrett and Henry Leggott of Bradford, state the object of their invention to be the production of an efficient machine for cleaning knives, at as small a cost as possible; and for this purpose they employ one, two, or more cylindrical brushes, which are enclosed in a box or casing of suitable size and form, and mounted in bearings so as to be easily caused to revolve. In the construction of

these brushes, strips of leather, buffalo hide, or other suitable substance is introduced between the bristles, and in some cases, metal springs are added to support the said leather or other substance; also at, or near, one end of each brush a groove is made, so as to receive a thin diaphragm or partition which forms a division in the box or casing; one part is for cleaning the blade, and the other for the hilt of the knife. When only one brush is used, one, two, or more pads or cushions are arranged arround it, which are pressed against it by springs, and for the insertion or withdrawal of the knives to be cleaned, these pads are forced away from the brush by the action of a cam or cams, and hand lever, or by any other suitable means. Openings are made in the casing for both blade and hilt of the knife to pass through, and in the diaphragm for the blade only, which passes between the pad and the brush, and into a supporting plate. When this machine is used, emery is introduced, and the knife or knives inserted are cleaned only on one side by the rotation of the brush they are afterwards withdrawn and replaced with the other side to the brush. In some cases the openings or slits in the diaphragm and the supporting plate are made so as to allow of the knives, after being cleaned on one side, to be turned over so as to be cleaned on the other without withdrawal. When two or more of these brushes are employed, they are placed in contact with each other, and the knife supports are so arranged that the knife may be between them at their point of contact, and so both sides will be cleaned at once.

Lamp to be used under Water.—An ordinary lamp consisting of oil-chamber and wick, is placed in a watertight translucent case or lantern. The air for the combustion of the lamp is admitted by a tube, the free end of which is supported above the surface of the water, and the products of combustion are carried off by a second tube, which is likewise in connection with the external air. The air in the lamp is rarified by the heat of the burning wick, and fresh air from without rushes in to take its place, so that a constant circulation of air is kept up and the lamp burns freely. If the outer translucent casing be made of glass, it is necessary to have it formed of two layers, so that air may be included between them, and in this way the outer layer is kept cool, and is therefore in no danger of being broken by the action of the cold water surrounding it. The lantern may be of any suitable form, but the inventor, Mr. John Ward of Port Glasgow, seems to advise the cylindrical as best suited to the purposes for which the lamp is intended; it seems also to be best adapted for repairing in case of injury. When glass cylinders are used, they are fitted to brass caps, one at the top, the other at the bottom, and the tubes for ingress of air and for the egress of the gases, are inserted into them; that for the supply of fresh air entering rather above the bottom, but that for its exit, together with the products of combustion, leaving the upper part of the cap, which, for convenience, is made in a conical form.

VEGETABLE HAIR.—M. Werner Staufen, Rue Auber, Paris, has discovered a method of preparing vegetable fibre so as to answer some of the purposes to which hair is applied. The material which he uses is the fibrous growth which appears at the foot of the palm, known as the *Levestonia chinensis.* He treats this substance, together with the adhering epidermis, as imported in the rough state, in the following manner. It is first disintegrated by an opening machine, it is then boiled in an alkaline lye, which may be composed of from five to ten pounds weight of soda or potash dissolved in one hundred gallons of water. The operation, which may occupy from half an hour to two hours, according to the strength of the lye, is continued until the gummy, resinous, and ligneous matters adhering to the fibres are completely removed. The material thus cleaned, is exposed to the action of a mordant, preparatory to its removal to the dyeing vat, charged with the required colour, to which may be added a certain portion of soapy matter, say from one to four pounds of oil soap to every hundred weight of the fibre. The dyeing process being completed, the mass is dried in the open air or artificially, and is afterwards submitted to the action of ordinary opening and combing machinery, by which the filaments are glazed and divided to the required degree of fineness. The fibrous material thus obtained may be applied to the different purposes for which horsehair, bristles, and other kinds of hair, have hitherto been employed as articles of commerce. When intended as a substitute for bristles (as, for instance, in the manufacture of brushes), the coarser fibres are selected and left straight, but when intended for stuffing, and similar purposes, in lieu of horsehair, they are curled in the same manner as that substance, after which they are steeped in water till softened, and finally baked at a high temperature (say about 140° Fah.). The finer fibres may be mixed, when so desired, with animal or other vegetable fibrous or textile matters, the proportions of such mixture varying according to circumstances.

INDURATING ARTIFICIAL STONE.—Artificial stone composed of lime, sand, or other silicious materials, is by this process of induration rendered coherent and enduring. The concrete mass when sufficiently dried to admit of manipulation, is placed in a chamber of suitable form and dimensions, and is there exposed to the action of carbonic acid gas, which is generated in the usual way, and conducted into the closed chamber by means of pipes. By the higher specific gravity of the carbonic acid the atmospheric air is expelled, and escapes by discharge cocks mounted in the upper part of the chamber, and the operation is continued until the absorption of the gas ceases, which may be determined by a pressure gauge, or other testing apparatus. As a general rule half an hour suffices for the saturating process above described; but the time occupied necessarily varies according to the nature of the materials under treatment. The inventor of this simple and apparently efficacious process, is Johann Georg Wilhelm Picker of Brunswick.

INSTRUMENT FOR CLIPPING HORSES.—Mr. William Clark of Baker Street, Portman Square, employs for this purpose a steel blade, which moves laterally, and meets the sharp edge of another steel blade fixed horizontally on a steel plate, beneath which fixed blade is placed a comb, projecting beyond it and the plate. The upper or moveable blade receives its motion from a handle, and works on a pivot, and moves in a quadrant slot, with a stop pin. The blade is worked by the right hand while the left is employed in pressing the steel plate on the skin of the animal, and in guiding it in its course. This invention is also applicable to cutting cloth, and to other similar useful purposes.

LITERARY NOTICES.

THE CANARY: Its Varieties, Management, and Breeding; with Portraits of the Author's own Birds. By the Rev. Francis Smith, Editor of "Arminius," etc. (Groombridge and Sons.)—A very elegant little book, ornamentally bound and illustrated by twelve exquisitely coloured plates of varieties of the canary. Few persons except bird fanciers are at all aware of the variations from the common form and colour which canaries present, and the present work will have the charm of novelty for most readers. Mr. Smith is quite an enthusiast for his pets, and details in an amusing way his various adventures and experiments in purchasing, breeding, and managing his birds. The believers in the fixity of species may derive some useful information from the portraits of Mr. Smith's favourites, for although the canary does not vary as much as the pigeon, the departures from the normal type are nevertheless very striking. Only professed ornithologists making careful investigations would conceive the wild canary figured in this book, and the Belgian varieties, to be specifically identical. "Lizards," "Yorkshire Spangles," "Norwich Yellows," "Belgians," "Green Birds," "Cinnamons," and "Turn Crests," are amongst the varieties figured and described by the author, and we shall be much surprised if his beautiful plates do not largely increase the demand for some remarkably elegant and not generally known forms. The "Cinnamons," for example, are most exquisite little creatures, in which the tint of the well-known spice, and the canary yellow, are beautifully contrasted. A large amount of pleasure combined with much curious information may be easily enjoyed by families, or young folks, who choose to follow Mr. Smith's directions. The book is written in a pleasing style, and will take its place as a popular manual and an ornament for the drawing-room table.

A MANUAL OF PHOTOGRAPHIC MANIPULATION: Treating of the Practice of the Art, and its various Applications to Nature. By Lake Price. Second Edition. (Churchill and Sons.)—Mr. Lake Price has taken evi-

dent pains to bring his well-known work down to date. The section on lenses is re-written, and contains elaborate descriptions of all the principal forms employed for various purposes, and he has been assisted by Mr. Warren De La Rue in his account of astronomical photography, and in that of micro-photography, by Dr. Maddox. This work may be regarded as a very complete treatise, well adapted to assist both professionals and amateurs.

ANILINE AND ITS DERIVATIVES; a Treatise upon the Manufacture of Aniline and Aniline Colours. By M. Reimann, P.D., L.A.M. To which is added in an Appendix, "The Report on the Colouring Matters derived from Coal Tar, shown at the French Exhibition, 1867, by Dr. A. H. Hofman, F.R.S., MM. G. de Laire and Ch. Girard." The whole revised and edited by William Crookes, F.R.S., etc. (Longmans.)—This useful epitome of the chemistry of the aniline colours will help to show the folly of the "technical education" humbug which quackery is endeavouring to substitute for real scientific teaching. The series of colouring matters obtained from coal-tar are quite unintelligible to persons who do not possess a reasonable acquaintance with theoretical chemistry, the doctrines concerning organic radicles, substitutions, etc. It is, of course, possible, that a mere "practical" man may tumble upon a further discovery, but his chances will be very small when compared with those of a really scientific chemist bringing his mind to bear upon the subject.

In August, 1856, Mr. W. W. Parkin discovered mauveine, the manufacture of which, on his plan, was rapidly taken up in France. In 1859, aniline red was produced at Lyons, and in a few months it was manufactured in London, Coventry, Glasgow, and Germany. In 1860, aniline blue made its first appearance, and within a year ten manufactories were at work upon its production, and as the report from which we take these facts observes, the west began to supply the east with colouring matters, and the artificial dyes were sent to China, Japan, America, and the Indies. The two most important substances employed in these manufactures are benzol and toluol, the former being a compound of the organic radicle phenyl, $C_{12}\ H_5$, with hydrogen (H), the latter is represented by the formula $C_{14}\ H_7\ H$, and other compounds of the series are formed by the union of hydrogen with hydrocarbon radicles containing larger proportions of their two elements. They are known at xylol, cumol, and cymol. Having obtained the benzols from coal-tar by distillation, the aniline dye-maker acts upon it with nitric acid, and obtains nitro-benzol, $C_{12}\ H_5\ NO_4$, together with water, HO. Aniline, though found in coal-tar, is obtained for manufacturing use by acting upon nitro-benzol so as to increase its hydrogen and take away its oxygen. Its formula is $C_{12}\ H_7\ N$. "Almost every aniline oil is produced by transforming benzol into nitro-benzol, and this latter into aniline. The benzols are all obtained from coal-tar, and will, therefore, all contain, substantially, the same hydro-carbons, though in different proportions." The exact cha-

racter of the aniline oils is a matter of great importance, and the work before us gives practical methods for their discrimination. An aniline oil containing toluidine is acted upon by some substance capable of oxydizing it, and rosaniline is thus obtained. When arsenic acid is employed for this purpose, arseniate of aniline is formed, which, on being heated, experiences a further change. The reaction is as follows:—

$$\underset{\text{(Toluidine)}}{2\,(C_{14}\,H_9\,N)} + \underset{\text{(Aniline)}}{(C_{12}\,H_7\,N)} + \underset{\text{(Arsenic acid)}}{3\,A\,S\,O_5}$$
$$= \underset{\text{(Rosaniline).}}{C_{40}\,H_{19}\,N_3} + \underset{\text{(Arsenious acid).}}{3\,A\,S\,O_3} + 6\,H\,O.$$

Rosaniline is the basis of magenta. The "night blue," which preserves its clear colour by candlelight, is a compound of phenyl with rosaniline —"a perfectly pure salt of triphenyl-rosaniline." Rosaniline is likewise the basis of phenylic violet, and of aniline green. The report observes that "rosaniline has become the parent of a whole series of colours. . . The gamut of colouring matters derived from aniline is now complete. We have red, orange, yellow, green, blue, indigo, and violet." These are all the result of discoveries intimately connected with theoretical chemistry. Dr. Reimann's book will be found full of manufacturing details, and it is illustrated with numerous figures of the apparatus employed.

THE FLORAL WORLD AND GARDEN GUIDE, edited by Shirley Hibberd, Esq., F.R.H.S. No. 8. (Groombridge and Sons).—This admirable serial begins the August number with the "Roses of 1868," illustrated by a handsome coloured plate of "Miss Ingram," a great beauty and novelty. The other articles relate to a variety of subjects, the Cauliflower, the Kalosanthus, Palms for Closed Cases, etc., etc. No one with a garden can be considered well informed without the "Floral World."

NOTES AND MEMORANDA.

THE BRITISH ASSOCIATION AND MR. DARWIN.—The present Meeting of the British Association has been remarkable for the ability with which Darwinian views have been put forward, and the just recognition of Mr. Darwin's splendid services as an observer. The President, Dr. Hooker, said that "the greatest botanical discoveries made during the last ten years have been physiological," and in this statement, "he especially alluded to Mr. Darwin's papers." The Rev. M. J. Berkeley spoke of Mr. Darwin's theory of Pangenesis (see STUDENT, vol. i., p. 185) as being likely, with modifications, to meet with acceptance. He pronounced Mr. Darwin the "greatest observer of the age," and defended his speculations against the charge of materialism, irreligion, etc.

EFFECTS OF FREEZING ON LIFE.—Dr. Richardson gave an interesting account to the British Association of his experiments on the effects of freezing the centres of the nervous system. He said that animals, such as frogs, which could be restored after freezing, did not respire in that condition, and were not destroyed by being placed in gases that would not support life. Professor Rolleston stated that, in the New York

WOMANKIND:

IN ALL AGES OF WESTERN EUROPE.

BY THOMAS WRIGHT, F.S.A.

(*With a Coloured Plate.*)

CHAPTER VI.

CONDITION AND COSTUME OF WOMEN IN THE TWELFTH CENTURY.

THE twelfth century was a turbulent period of transition, both in France and in England, from an old state of society to a new one. It witnessed in both countries the great struggle between kingly government and feudal power, and, at the end of it, the advantage remained with the crown. Our materials for the history of Womankind during this period are very scanty.

The position of women had been, in some degree, raised during this period, especially among the aristocracy. Our kings of the Norman line granted the hereditary right of succession to such titles of nobility as earls, barons, etc., without exception of sex; so that, on failure of male heirs, the title should devolve and be confirmed to the women, and they could convey it by marriage into other families. Thus ladies became nobles in their own right. On the other hand, the authority of the father over his daughters, in regard to giving in marriage, had been transferred to the feudal lord, or at least was placed under his control; and his right to the disposal of wards was more strictly enforced than ever, and was made a means of profit and extortion. Some of the old writers complain of the inconvenience of this practice, by which, as one of them says, "Wards were bought and sold as commonly as were beasts." In the letter or charter of Henry I., prefixed to the laws of that monarch, and written in the first year of his reign, A.D. 1100, or 1101, he promises to act in regard to his authority over his barons in this regard, with the utmost disinterestedness. "And if," he says, "any one of my barons or men wish to give in marriage his daughter, or sister, or grand-daughter, or kinswoman, let him talk to me about it. But I will neither take anything from him for this licence, nor will I forbid him to give her, unless he should intend to unite her with my enemy. And if, my baron or other man being dead, his daughter remain his heir, I will give her with her land by the advice of my

barons. And if, the husband being dead, his wife survive, and be without children, she shall have her dower and marriage (maritationem), and I will not give her to a husband, except according to her will. But if the wife survive with children, she shall have her dower and marriage, as long as she shall keep her body lawfully, and I will not give her, except according to her will; and either the wife or some other near of kin shall be the guardian of the land and children. And I order that my barons shall forbear similarly towards the sons or daughters or wives of their men." Such was woman's position under feudalism; forbearance was proclaimed nominally, but was far from being the practice, as appears by the writers just quoted.

The innovations introduced into the marriage ceremonies, by the Normans, were few, and not of much importance, with one exception. Two persons, desirous of contracting matrimony, were required to be asked publicly three times in church, unless they obtained a dispensation from the bishop of the diocese. This was, as will be seen at once, the origin of our modern practice; but it was a new step on the part of the Church to secure the occasion for interference in marriages. A law was also made under Henry I., by which no contract between a man and woman concerning marriage, without witnesses, should stand good if either of them denied it.

During this same twelfth century, the interference of the Church in marriages and divorces was continually exercised, and in a manner which made it almost insupportable, the more so as it became a mere instrument of political intrigue. We know not to what extent it was carried among the middle classes, where the Church gained less by its interference, but it enters largely, and rather scandalously, into the history of the kings and great feudal chieftains. Louis VII., of France, had married Alianor, Duchess of Aquitaine; but, after a time, great disagreement arose between them. It was said that Henry Plantagenet, Duke of Normandy, and Count of Anjou, persuaded her to apply for a divorce, in order to marry herself, and thus obtain with her the duchy of Aquitaine. The case was laid before an ecclesiastical council held at Beaujenci in 1152, at which the marriage was annulled on the plea that it was unlawful and incestuous by reason of the near relationship between them. This "near relationship" had to be traced back to Hugues Capet, who was the great-grandfather of the grandfather of Louis VII., and who had married a sister of Guilhem Fier-à-bras, the great-great-grandfather of Alianor. But the bishops were satisfied, and granted the

divorce. The marriages of Philippe-Auguste were equally a cause of serious difficulties. Through political motives, Philippe married Ingeburge, sister of the king of Denmark, on the 24th of August, 1193, and she was crowned by the Archbishop of Rheims next day. Before the ceremonies of the marriage were ended, Philippe was seized with an invincible antipathy to his wife; and three months after, the bishops, assembled in a council at Compiegne, over which the same Archbishop of Rheims presided, pronounced the marriage null on the usual plea of affinity of blood. Ingeburge appealed to the pope, Celestine III., who, in the March of the year 1196, annulled the decision of the council, and enjoined the king to take back his wife. But, instead of obeying, Philippe, within three months, married again, taking for his queen the Princess Marie of Merania, to whom he was tenderly attached. Some eighteen months after this, Innocent III. succeeded to the papacy, a man exceedingly proud and overbearing, and one of his earliest acts was to address a bull to the king of France, ordering him to put away his "concubine" and to return to his lawful wife. As Philippe remained disobedient, the pope proceeded, after a year spent in attempts to appease him, to place his kingdom under an interdict. The evil resulting from this measure was so great that the king was obliged to yield, and Queen Marie was separated from her husband, and Ingeburge restored. The real cause of the pope's hostility arose from his jealousy of the Gallic bishops, in whom he refused to acknowledge the power of granting the divorce; and, on Philippe's submission to him, he obtained a divorce from Rome, but Queen Marie had died in childbirth during her separation. At the council of Rheims in 1119, Hildegarde, Countess of Poitiers, presented herself and complained that her husband, who had been separated from a first wife before marrying her, had repudiated her and taken to his bed Malberge, the wife of the Viscount of Châtellerault. At the council of Clermont, a few years earlier, one of the principal subjects of complaint was, that it had become a common practice for persons to put away their lawful wives, procure divorces, and take the wives of other men. Thus the Church having taken into its own hands the power of marriage, repudiation, and divorce, this was abused in all possible ways.

There is another subject to which we shall have to revert in a subsequent chapter. The Anglo-Saxon clergy, and no doubt the Frankish clergy also, had wives, to whom we have every reason to believe they were duly married. The new party in the church—perhaps we may call it the high church party—set their faces

against the marriages of the clergy—they sought to separate as widely as possible the clergy from the laity in interests and in feelings, thinking, no doubt, that a priest with a wife and family could not fail to sympathise in some degree with common humanity, to unite, in fact, in the cause of the laity around them with whom they had contracted a worldly relationship. Hence the canons passed at the various ecclesiastical councils held in France and England during the eleventh and twelfth centuries, are filled with injunctions against the marriage of the clergy, and, in fact, against all intercourse between them and the other sex. It is evident from a multitude of facts, that the clergy in general were very little inclined to yield this point, but by the middle of the thirteenth century the marriage of the clergy appears to have been generally abolished.

Extravagance in the display of jewelry and of rich materials in the dress had increased greatly towards the end of the twelfth century, and were still on the increase. Among the new substances, derived like so many of the others from the East, was one common enough now, but then greatly prized—*cotton*, which appears to have been introduced into France in the twelfth century. The name cotton, which was brought from the East, was given to it by the French. The Germans gave it a name taken from its nature, *baum-wolle, i.e.*, tree wool. It was called in medieval Latin *bombax*. Jacques de Vitry, who wrote in the thirteenth century, describes it as "a mean between wool and linen," and says that it was used for making stuffs of very fine texture.* Cotton appears to have been in general use during the thirteenth century.

The use of silk, at this time, among the higher classes, was very considerable, and it was mixed perhaps with other substances, and received various colours, so as to form a variety of silken stuffs known under different names. The principal of these was what was called *cendal*. It is supposed to answer nearly to the modern taffetas, and was of various and rich colours. Another silken stuff, much in use, was called *siglaton*, which is spoken of in the romance of Partenopex de Blois, an early work of the thirteenth century, as an importation from the east; for one of the personages of the story "looking towards the sun-rise," a list of the various objects which came from that quarter is given, and among them are the hairs from Alexandria, and "the good siglaton."

* "Sunt ibi præterea arbusta quædam, ex quibus colligunt bombacem, quæ Francigenæ *cotonem* seu *coton* appellant; est quasi medium inter lanam et linum, ex quo subtilia vestimenta contexuntur." Jacobus de Vitriaco, lib. i., c. 84.

> "S'esgarde vers soleil levant . . .
> Par là li poile Alixandrin
> Vienent, et li bon *siglaton.*"

Another rich silken stuff, usually embroidered with gold, was called *samit,* and appears to have been usually employed in the making of robes for the bishops; we learn in the life of St. Louis, that that monarch kept in reserve such robes "of samit and other valuable stuffs made of silk" (de *samit* et d'autres dras de soie precieus). Velvet was also now in use, called in the Latin of the time *pannus villosus,* or downy cloth.

I might enumerate other names of cloths and stuffs in use as early as the twelfth and thirteenth centuries, for there appears to have been a great variety of them, but some of them are seldom mentioned, and were probably not much in use, while others were employed only in dresses for men. *Saie,* in medieval Latin *sagum* or *sagus,* was a cloth of very fine texture made of wool. It appears to have been often employed to evade the ecclesiastical rule which enjoined by way of penance the wearing of a woollen garment, intended of course to be rough, next to the skin. *Camelot,* or *camelin,* which also came from the East, is said to have been made of the hair of camels. Some of these cloths were died of very rich colours. In the latter part of the twelfth century, and in the thirteenth, embroidery of various kinds were employed in these stuffs, and in the dresses made from them, to a very extravagant degree. It was not unusual to have the crests and armorial bearings of the family embroidered upon the outer dress; and it was often covered with large figures, not only of plants and flowers, but of animals also. At the council of Montpelier, early in the latter half of the twelfth century, among other complaints against extravagance in costume, it was stated that the ladies of that time wore dresses covered with such fantastic figures that they rather resembled monsters or demons than human beings.

The accompanying cut, from an illuminated manuscript of the twelfth century in the Imperial Library in Paris, is here taken from one of the plates to the important work of M. Louandre, "Les Arts Somptuaires"—it represents two noble ladies, with a chambermaiden serving one of the ladies with water to wash. The lady to the left, who wears a curiously shaped hat or coronet, has a grey gown or outer-tunic, and over it a red mantle with a white border. The lady to the right wears a grey outer-tunic, with a yellow border, and an under-tunic of very light brown. Her head is enveloped in a grey couverchief, or hood. She carries a book in her hand. The

chambrière wears a white tunic, with grey and green stripes. Their shoes are similar in shape, of brown colour, spotted, the spots being in the first lady white, in the chamber-damsel red, and in the second lady mixed white and brown.

NOBLE LADIES AND CHAMBER-MAIDEN.

The second cut, a selection from another illuminated manuscript preserved in the Imperial Library in Paris, presents a group of figures of men and women, belonging also, probably, to this same period, the latter part of the twelfth century. They furnish a good example of the varieties of costume then prevailing among both sexes. The lady to the right wears a white dress, with a hood similarly of white material. The hood of the other female is black with white stripes. Her outer-dress, as seen here, is salmon coloured, with red spots, and dark-red lining. Her tunic is yellow. They have both the hanging sleeves, but, at the date to which these figures belong, they were evidently beginning to be worn shorter.

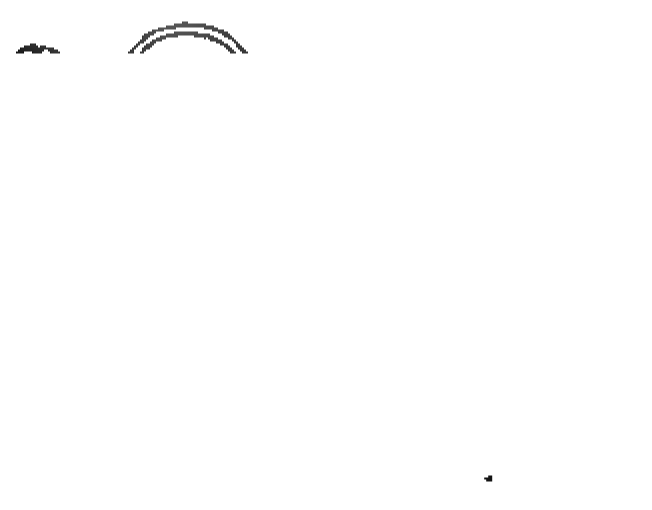
In the dresses of the men the prevailing colours are blue and red. The shoes are all of a dark colour with white spots.

The hair was still considered as an object of great importance, and was preserved and dressed with a sort of superstitious reverence.

COSTUMES OF THE LATTER PART OF THE TWELFTH CENTURY.

The manner in which it is arranged in the two principal figures in our first cut is concealed by the position in which they are placed, and by the coverchief of one of them; but in the case of the chamber-maiden, it is plaited, or twisted, very long behind, and apparently enclosed in a case, like that of some of the ladies in our last chapter. The importance attached to the hair was, as we have seen, of old date, and was shown in many acts of ordinary life. It was usual with persons of either sex, to give a lock of the hair as a pledge of faithfulness to an agreement or to a contract of friendship, whence we derive our modern practice of preserving a lock of hair as a memorial of affection. We still find the matron generally

wearing the coverchief, as in the three figures given in our third cut, which are enameled in Limoges work on the back of a copper



A GROUP OF LADIES OF THE TWELFTH CENTURY.

figure of the Virgin seated in a chair. It is related of the Cotterieaux, or freebooters, who at this time overrun the country in large troops, that they robbed the churches of their corporals to make vails of them for the loose women who wandered about with them.

THE JÁVÍDÁN KHIRAD; OR, THE PROVERBIAL PHILOSOPHY OF ANCIENT PERSIA.

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The annals of Bibliography often present features as romantic as those of Chivalry itself. From the finding of the manuscript of Aristotle's "Politics" in the Temple of the Sun at Heliopolis, to the recent discovery of the "Codex Sinaiticus" by Tischendorf, the history of literature abounds in strange and stirring incidents. As might be expected, these Bibliographical romances are more frequently met with in the East than in the West, and there is scarcely a single work of any note or antiquity to which some legend relating either to its preservation or discovery does not attach. Of such a character is the history of the "Jávídán Khirad," or Eternal Wisdom, a book hitherto entirely unknown in Europe, and, for the majority of Eastern writers, possessing little more than a traditional existence.

The first notice of the "Jávídán Khirad" in any Western writings, seems to have been given by Thomas Hyde in his "Historia Religionis Veterum Persarum, etc., Præfatio," he says: "Apud Persas autem extat alius liber, Zoroastrianis Scriptis antiquior, cui titulus 'Gjavedán Chrad,' seu æterna sapientia agens de Hikmat 'Amalí, sapientia practica, cui auctor fuit medorum Rex tantum non antiquissimus Hûshangh, occisus (ut aiunt) ictu lapidis, qui a nostrate quodam exponitur Hermes." "There exists amongst the Persians another book, more ancient than the Zoriastrian writings, which bears the title of 'Gjavedán Chrad,' or Eternal Wisdom, and treats of 'Hikmat í 'Amalí,' or Practical Philosophy. Its author was Hosheng, nearly the first of the Median kings, who met his death, it is said, by a blow from a stone, and who has been identified by one of our countrymen with Hermes." The "Desatir," of which I have treated in a previous paper, mentions the "Jávídán Khirad" as a divinely inspired work revealed to Hosheng, and all the histories of the earlier Persian dynasties when speaking of that monarch, assign to him the composition of a book bearing that name. But the first substantial account given of the book, is that of Abu Ali Maskúyeh, an Arab writer of the tenth century, who professes to relate the discovery of some fragments of the lost book containing the testamentary precepts of Hosheng to his son Tehmuras. This narrative must decidedly be taken *cum grano salis*, but as its veracity is not called in question by oriental writers, and the precepts which it introduces are universally accepted as the genuine legacy of Hosheng, it at least deserves our attention.

Before proceeding with Maskúyeh's account of the "Jávídán Khirad," it will be well to narrate what is known of its reputed author. Mírkhond, the writer of the celebrated Persian History, entitled, the "Rauzat ul safá," says: "the most celebrated historians consider this prince to have been the grandson of Kaiomers,* while others maintain that he is identical with Mahaleel, and that Cainan is the same as his father Kaiomers. From his unparalleled justice he was styled Pesh-dád (Foremost in Justice), and founded the dynasty of that name. Hosheng is the author of a book on moral philosophy, entitled, 'Jávídán Khirad,' a part of which was translated from the Syriac into Arabic by Hasan, brother of Fázil ibn Sahal, who was for a long time vizier to the Caliph Mámún al Rashíd. Abu Ali Maskúyeh subsequently quoted Hasan's

* The first king of Persia, and according to the Magians, the first created human being.

translation in his 'Ádáb al 'Arab w'al Furs,' or 'Literature of the Arabs and Persians.'" The Persians claim for him the rank of a prophet.* It is said that some demons, having watched an opportunity when he was engaged in an act of devout adoration in a cave, overwhelmed him with stones and slew him. His son, Tehmuras, revenged the death of his father, and built a city upon the scene of his murder, which he called *Talkh* (Bitter), a name which, in later times, became corrupted into Balkh. He is related to have been the first person who introduced the arts of civilized life, and to have taught the uses of metals and the properties of precious stones. Some people even ascribe to him the formation of the Tigris canal, and the erection of Sús, Kúfeh and Babel. He reigned forty years. This account is repeated with slight variations by nearly all the Persian historians. Tabari, and some others, however, have extended the forty years of his reign to four hundred. The last mentioned writer adds, that the Magians claim Hosheng as a fire-worshipper, and that the Jews, on the other hand, declare that he was a follower of their religion. Firdausí, also, in his "Sháh náma" (Book of Kings), assigns to Hosheng the discovery of the art of producing fire from a flint, and attributes to him the introduction of fire as a symbol of the Deity. These differences of opinion concerning the religion of Hosheng, accord well with the account elsewhere given, which makes him the founder of a new and mystical faith.

The book from which the following account of the "Jávídán Khirad" was taken is a Persian version, or rather, paraphrase, of Abu Ali Maskúyeh's work of that name, and was written about the middle of the sixteenth century, by Ibn Hajji Shems ul Dín Kílání Mohammed Husain, for the then governor of the province of Málwah in India. The volume forms part of a collection of Oriental Manuscripts, presented by Mr. Burzorjee Sohrabjee Ashburner, a Parsee gentleman of Bombay, to the Royal Society of Great Britain, and was at the donor's request placed in the hands of the writer for translation.

A brief extract from a letter received from Mr. Ashburner will explain how it came into his possession:—"My oriental studies were conducted under a highly gifted Zoroastrian Persian, the late lamented Shiavaksh bin Hormuzdiar, who had travelled down to India on some literary business. Under him I studied the Persian edition of that unique work, the 'Desatir,' which relates to the history of the Mahabadi tribes. In this book I met with the name

* See Article on "Desatir," STUDENT, i. p. 413.

of the prophet Hasung, and that of the 'Jávídán Khird,' as the sacred work which he left to our forefathers. My curiosity was naturally excited to get this most ancient testament of ours, and my learned teacher, having met with a copy of it in Persia, sent for it for my use. That copy is now in the possession of the Royal Society, and is the one which you have now received for translation."

I have compared the work throughout with the Arabic original, a copy of which was kindly lent me by the Warden and Fellows of St. Augustine's College at Canterbury—the two manuscripts which I have thus used being, I believe, the only copies existing in Europe.

The following is a translation of Abu 'Ali Maskúyeh's account of the "Jávídán Khirad." He says: "In the flower of my youth I was perusing the work by Abu 'Othman Jákhit, entitled the 'Istitálat al Fahm' (the Extent of Understanding), in which he so warmly praises the "Jávídán Khirad," or Testamentary Advice of Hosheng, to his son. His enthusiasm induced me to search for a copy of the book; but it was not until after considerable trouble that I succeeded in procuring one from Persia. Now, although I found the book full of the most excellent and interesting sayings, yet I remembered parallel passages in the writings of many of the sages of Persia, Arabia, Greece, and India: for this reason I have compiled a work comprising the didactic remains of the sages of the four quarters of the globe, to the end that the learned may be reminded afresh of their maxims, that the young may be guided aright, and that I myself may obtain a reward hereafter.

"With regard to the origin of the 'Jávídán Khirad' itself, Abu 'Othman Jáhiz relates of Fazl ibn Sahal, who was vizier to Mamún, that when Mamún was proclaimed caliph in Khorassan, the monarchs of all the surrounding countries sent ambassadors to offer him their congratulations, and convey to him some present, in token of their good will. Amongst these envoys was a sage sent by the ruler of Cabul, Zobán by name, who presented a letter from his royal master, couched in the following words: 'I send you herewith a present, which for worth and importance has nothing to equal it in the world.' Mamún's curiosity being aroused at this, he enquired of Zobán what it was he had brought. That sage replied, 'Nothing, sire, better than the knowledge which I possess.' On being further questioned as to the nature of that knowledge, he said, 'It consists in foresight and discretion, and unerring judgment which invariably secures success.' Mamún received him with the greatest reverence,

and lodged him in the best apartments of his palace, giving strict orders to his retainers not to divulge the nature of his visitor's business. Some time after, when, on the death of Haroun al Raschid, a dispute arose between Mamún and his brother, Mohammed Amín, which ultimately ended in hostilities; Mohammed Amín sent an army to invade Khorassan. One day the news reached Mamún that his brother's forces had proceeded as far as Iráq. He at once sought Zobán, and asked his advice concerning the advisability of despatching some troops to intercept the invaders before they had actually set foot in his dominions. 'The proposal,' said Zobán, 'is a good one, and victory nearly certain.' Acting on this advice, he despatched his troops and gained a signal victory. This, however, was not the first occasion on which Zobán's sagacity had stood Mamún in good stead, and he accordingly acknowledged his sense of gratitude by presenting the sage with a purse of a hundred thousand dinars. Zobán courteously but firmly declined the proffered gift, and said, 'The King of Cabul did not send me here because I was in want. My reasons, however, for rejecting this sum is not that I fail to appreciate your munificence, or deem the amount too little, but because I hope to obtain from your majesty a greater and still more handsome recompense: I mean a book which lies buried beneath the palace of the Khosroes.'

"When Mamún reached Baghdad, he requested Zobán to point out the spot in which he supposed the treasure to be concealed. This he did without hesitation, and the Caliph gave orders for the immediate excavation of the place. The workmen, digging under Zobán's directions, presently came to a broad, flat stone, underneath which they found a chamber containing a small casket of black crystal, securely locked. This they removed and carried to Mamún, who asked Zobán if it were the treasure he was seeking. Zobán replied that it was, and the Caliph then said: 'The box, you see, is sealed, and the seal remains intact; there can be no suspicion, then, of my having tampered with it.' Zobán assured him that he had never entertained the least suspicion of the purity of his majesty's motives, and proceeded to open the casket in his presence. Inside it was a purse of gold brocade, which he took to Mamún, and turned upside down. From this fell out a few discoloured leaves of paper, which Zobán carefully gathered together, replaced in the purse, and secured about his own person. Then, giving the casket to Mamún, he bade him preserve it, as it would be 'useful for holding *bijouterie*,' and took his leave.

"'Now,' says Hasan ibn Sahal, 'I said to Mamún, I wish you

had asked Zobán the contents of those leaves.' 'I, too, wish the same,' said the Caliph, 'but I refrained from motives of delicacy.' When Zobán had left the presence," continues the narrator, "I followed him home, and begged him to gratify my curiosity concerning the mysterious documents. He informed me that it was the book entitled 'Jávídán Khirad,' a treasure extracted by an ancient King of Irán from the sayings of the wise men of old, and handed me a leaf to peruse. On looking over it, I found that it was entirely in an unknown character; but, fancying it to be the ancient Persian, I sent for Khizr ibn 'Abdallah, who was well versed in Pehlevi writing, and who quickly read and interpreted it to me.

"I copied it from his dictation into a book, and when I had finished that leaf I borrowed another from Zobán, until I had completed in all about thirty. I then went to him, and said, 'Oh Zobán, is there anything in the world better than a science like this?' He said, 'If it were not a science to be guarded with the greatest care, containing as it does all that is needful for this world and the next, I would have given you the whole book to copy; but as it is, I cannot find it in my heart to give you more. You must, therefore, be contented with what you already have, for the remaining leaves contain some secrets which must not be divulged.

"One day," continues Hasan ibn Sahal, "Mamún asked me what books in Arabic were most instructive. After enumerating some works on war and travel, I was proceeding to mention some of the more celebrated commentaries upon the Coran, when the Caliph stopped me, and bade me not compare the Word of God to any other book. He next asked me what books in Persian were the best. I told him of the most important works in that language, and ultimately spoke of the 'Jávídán Khirad.' On hearing this name, Mamúm called for the librarian and ordered him to bring the catalogue; when he could not find such a work there, he said, 'How is it I cannot see the name of that book here?' I said, 'That book, oh Emír, is one which I myself wrote from the leaves which Zobán took away with him.' At his request I sent some one to fetch it from my own house, and placed it in Mamún's hand. When it arrived the Caliph had just finished his prayers; so he rose up, turned his face from the Kiblah, and began to read it. When he had finished one chapter, he exclaimed, with wonder and approbation, 'There is no god but God!' and applied himself again to the perusal of the book. In this way the time for prayer came round again, and the Caliph was still intent upon the book, so that I had

to remind him of the fact, and tell him that although the time of prayer was running away the book would not. 'You are right,' said he; 'but my mind is so taken up with that book, that unless I finish it first, I fear lest I may make some shortcomings in my prayers, a thing that I have never yet been guilty of.'* So he again applied himself to his task, and continued reading until he had finished all that was written. He then asked where the conclusion of the book was, and I told him that Zobán had refused to give it up to me. 'If Zobán were not under my protection, and an ambassador,' said he, 'I would assuredly have sent after him, and taken it from him by force.'

"You see," says Abu 'Ali, "how excessively fond Mamún was of the book, and how reluctant Zobán was in giving permission for it to be copied. In truth, the book is, as I have said, the repository of the maxims of the great and the wise, and contains the embryo imaginings of the men of olden times. When you peruse the subjoined translation for yourself, the extreme beauty of its contents will be manifest to you. May God give you grace to read them aright."

THE MAXIMS OF HOSHENG.

Hosheng, a king of the Peshdádian dynasty, saith:—

The origin of all things is in God, and unto Him is the return; all good grace cometh from Him, and He is worthy to be praised. Whoso, then, knoweth the Origin, it is incumbent on him to be thankful; and whoso knoweth the end, he should be sincere; and whoso knoweth what grace is, it is his duty to acknowledge his own weakness and insufficiency.

The path of virtue lies in the renunciation of arrogance and pride.

The best thing that hath been given to man in this world is wisdom; the most goodly gift that can be given him in the next is pardon. The best disposition for him is that he should have a lively appreciation of the high and godlike character of his own nature, so that the thought may keep him from evil, or cause him to repent if he have done wrong.

The best possession of man is health; his best confession that of the unity of God.

Theory is the basis of certainty; practice is the pillar of theory; and both are founded on Divine Laws, which can only be comprehended by reverent investigation.

Religion is like a fortress raised and supported by columns and towers; should one column be allowed to totter, the whole fabric will give way.

* The Oriental princes were often very devout in the performance of their religious duties. I remember H. H. Nawab Ikbal Ooddowlah telling me, in the course of conversation, that his father, the late king of Oude, had never missed one of the five daily prayers in the course of a life of more than sixty years.

Good works are of four kinds:—Theory, Practice, Sincerity, and Continence. Theory is the endeavour to ascertain your duties, Practice is the performance of them; Sincerity is the renunciation of envy, hatred, and malice; and Continence is patience and the forsaking all worldly vanities.

Four things also constitute the business of man:—Knowledge, Charity, Chastity, and Justice. Knowledge of what is good, to perform the same, and of what is evil to avoid it; Charity, to improve men's spiritual condition and alleviate their temporal wants; Chastity, to guard oneself in the temptations of desire, and to preserve one's reputation in the time of want; Justice, wherewith to temper success, that proper bounds may be set to one's wrath, so that it be not excessive in the time of power, or deficient when it is required.

Knowledge consists in four things:—to know the root of Truth, the branches of Truth, the limit of Truth, and the opposite of Truth.

Theory and practice are as closely conjoined as soul and body; neither can profit its possessor without the other.

Truth is of two kinds: one manifest and self-evident; the other requiring demonstration and proof; and vanity is like unto it in this respect.

There are four things which increase by use: Health, Wealth, Perseverance, and Grace.

The way of salvation lies in three things: Divine Guidance, Perfect Piety, and a Godly Life.

Theory is the root, practice the tree; theory is the father, practice is the son. Practice may serve instead of theory; but the latter can never take the place of the former.

To enjoy the day of plenty you must be patient in the day of want.

The greatest wealth consists in three things: a prudent mind, a stalwart frame, and a contented spirit.

Expel avarice from your heart, so shall you loose the chains from off your neck.

He who does wrong knowingly will regret it, though men may applaud him; but he who is wronged, is safe from regret though the world may blame him.

The contented man is rich, hungry and naked though he may be; but the covetous man is a beggar, though he may possess the whole world.

True bravery is to face the world with a frank and open heart; true patience is in bearing up against disappointments; true liberality is in rewarding merit, and bestowing wealth in the proper time and place; true clemency is in foregoing revenge, when it is in one's power; true caution is in taking advantage of opportunities.

This world is the house of work; the next world is the house of reward.

The reins of health are in the hands of sickness; the head of safety is beneath the wing of danger; the door of security is veiled by the curtain of fear. Therefore, in sickness, danger, or fear, do not despair of the reverse.

Oh, man! thy doom is nigh, in other hands than thine; it watcheth like a thief by night and day, and when once thy time hath come small leisure shalt thou have for preparation. Strive, then, to prepare ere the evil day arrives, and comfort thyself with the thought that all the great and good have been companions in thy misfortune.

Oh, son of man! make not thyself a target for the arrows of misfortune

for time is the enemy of men, and it is the duty of the wise to be on their guard against their foes. If, then, thou thinkest well of thy soul and of its enemies, thou wilt stand in need of no preacher to advise thee how to act.

In prosperity dread misfortune, for unto it thou must return; when anticipation is fairest, then think on tardy fate, for though he be slow yet is he sure.

Excuse is better than disputation; delay is better than rashness; ignorance of strife is better than eagerness in seeking it.

To feel sure in war that it will end well is to lay up a store of woe; if then, ye must make war, be brave in action that ye may be victorious, and anticipate not victory lest ye be overthrown.

The slightest provision against a quarrel is better than the stoutest persistence in carrying it on.

It is wrong to give the lie direct save in three cases. When one speaks unwisely, and the consequences are likely to prove evil to him; when one speaks ungratefully of a benefactor; when he glozes over an unlawful proposition.

There are three things which can in no wise be used for good: malice, envy, and folly; and there are three things that can by no means be employed for evil; humility, contentment, and liberality.

There are three things of which one can never tire, health, life, and wealth.

A misfortune that cometh from on high cannot be averted; caution is useless against the decrees of fate.

The best of medicines is death; the worst of maladies is vain anticipation.

Three things bring us joy in the world, and three things cause us grief: the former are resignation, trust in God, and cheerful obedience to His commands; the latter are avarice, importunity, and yearning after evil things.

Of worldly things four are good; home, a good wife, wealth, and wine; four are evil; a large family, a small income, a treacherous neighbour, and a bad wife; four are hard to bear, old age and solitude, sickness and exile, debt and poverty, and a sore foot and a long road.

Three things cannot be got with three things: wealth, with wishing; youth, with cosmetics; health, with medicine.

If a man lose all else, and four things still are left him, he can take no harm; Temperance, Cheerfulness, Truth, and Trust in God.

Six things temper the hardships of this life: good diet, a kind friend, a faithful wife, an obedient child, a prudent tongue, and a wise head.

An easy temper is a good counsellor, and a pleasant tongue is an excellent leader.

Foolish pride is an incurable malady; a bad wife is a chronic disease; and a wrathful disposition is a constant burden.

Three things seem fair in three cases: a gift to a hungry man, the truth from an angry man, and forgiveness from one who has power to take revenge.

The wise man is he who hopes not for what is wrong, who begs not for what he fears may be refused, and who undertakes not what he cannot perform.

There are three things which make a poor man rich: courtesy, consideration for others, and the avoidance of suspicion.

Eight things are proofs of folly: ill-timed wrath, misplaced bounty, ill-judged exertion, the confounding of friend with foe, confidence in those untried, reliance on the foolish, trust in the faithless, and garrulity.

A tyrant loses the dignity of his office, and grows like unto the meanest of his slaves.

When faith goes out misfortune comes in; when confidence dies revenge lives; and when treachery appears all blessings fly away.

Trifling ruins earnestness, lying is the enemy of truth, and oppression perverts justice; therefore, when a king passes his time in trifles, people lose all awe of him; when he associates with liars men despise him, and when he is tyrannical he weakens his authority.

Dominion is perfected only by good administration, and he who seeks it must be patient of losing it.

By bearing the loads of men dignity is reached; by virtue rank is honoured; by morality are deeds refined.

Good advice to one who will not accept it, arms in the hands of one who knows not how to use them, and gold in the possession of one who benefits not mankind, are things wasted and lost.

A king should have three habits: tardiness in punishing, alacrity in rewarding, and patience in accidents; for verily in delaying punishment is the possibility of pardon; by alacrity in granting rewards, the hearts of the people are won; and by patience in accidents the right course of action may be ascertained.

The man who is cautious in a doubtful matter is like unto him who, having lost a pearl, collects all the dust that is around the place where it hath fallen and sifts it until his lost treasure comes to light. For thus doth the cautious man collect the opinions of all in a doubtful case, and sifts them one by one until that counsel cometh to light which is suited for the emergency.

Caution can never incur disgrace, and imbecility can never bring honour with it. Caution conducts to success; imbecility induces disappointment.

By four things are great men brought low: by pride, by taking counsel with women, by keeping the company of the young and foolish, and by neglecting things that require their personal supervision.

A king deserves not the name until he eats from his own field, gathers from his own garden, rides his own horse, and marries from his own country.

Good administration is from good management, good management from good counsel, and good counsel is only to be found with wise and sincere advisers.

The reins of good administration can be held only by reverencing elders, being just to equals, and encouraging inferiors.

The duties which the wise man owes are these: to God, obedience and gratitude; to the king, sincere loyalty and counsel; to himself, earnestness for good and avoidance of evil; to his friends, liberality and faithfulness; and to mankind generally, courtesy and protection.

A man is perfected only by three things: by being great in the sight of others and little in his own esteem, by despising wealth for its own sake, and by being truthful under difficulties.

Perfection consists in religious knowledge, patience in affliction, and good fortune in worldly affairs. Perfect piety consists in trust in God, acquiescence in fate, and patience in loss.

Faith consists in four qualities: belief, self-sacrifice, sincerity, and obedience.

Whomsoever riches do not exalt, poverty will not abase, and calamity cannot cast down.

The perfect man is he who is proof against the vicissitudes of fortune, and who looks well what the end shall be.

There is no equivalent for religion, no compensation for time, and no substitute for one's own soul.

Since night and day are the steeds of man, they hurry him on, not he them.

Whoso combines liberality with moderation will make good out of evil and wrong.

Whoso regards not complaint confesses his own meanness, and whoso makes a merit of his charity incurs reproach.

There are four things of which a little goes a long way: pain, poverty, error, and enmity.

The man who knows not his own worth will never appreciate the worth of others.

He who is ashamed of his own trade will be compelled to take up with that of some one else.

Whosoever is ashamed of his father and mother, is excluded from Divine guidance.

He who is not lowly in his own eyes will not be exalted in the eyes of others.

In every blessing think upon its decay, in every misfortune think upon its removal. For such remembrance doth preserve blessing, and keep us from the intoxication of pride, and bringeth more real pleasure with it.

If justice predominate not over injustice in a man he will speedily fall into ruin; for tyranny more than aught beside causes the decay of prosperity.

Vain hopes cut man off from every good; but the renunciation of avarice prevents every ill.

Patience leads to power, but lust leads to loss.

By asking counsel in a matter it shall end aright; by relying on God cometh increase day by day.

By the sincerity of his earnestness man earns rewards; by the sincerity of his profession he gains friends.

In proportion as we avoid evil we gain God's good grace; as we gain that we attain to earthly happiness.

By wisdom is the gift of knowledge displayed; by knowledge are high things obtained.

By the descent of calamities are men's virtues proved, and by long absence are their friendships tested.

In information is shown the wit of a man, and in travel are tempers tried. In poverty is benevolence assayed, and in the moment of anger is a man's truthfulness displayed. By its influence on a man's mind is shown the vigilance of his guardians, and by right discipline cometh the inspiration of knowledge. By leaving sin one is freed from vice, and in retirement is wisdom made to stand By Divine grace are works kept aright, and by the results are purposes shown. By a trusty comrade is a man supported in life, and by recompence are friendships increased. In seclusion is brotherhood proved, and by faith-

fulness familiarity is increased. By following wise counsel one attains to wisdom, and by a good intention is the companionship of the righteous secured. By shaking hands with deceit one is tossed on the billows of toil. Fear of judgment will deter from wrong, but trifling leads to destruction.

Whoso cannot forgive wrong done to him can never know the worth of good that is done unto him.

Separating yourself from the society of fools is the same as cleaving unto the wise.

He who bestows bounty on mankind accustoms them to be generous unto him.

The envious man is never great.

Intelligence is shown by good management.

Whoso clotheth himself in modesty will conceal his faults.

The best etiquette for a man is not to boast of his virtues, and not to show off his power to one weaker than himself.

Learning clears the wit.

He who takes advice is secure from falling; but whoso is obstinate in his own opinion falleth into the pit of destruction.

The contentious man induces antagonism, for people cannot often repress their anger, especially when contending with fools.

Three men are never distressed by adversity or exposed to solitude and grief: the brave man, of whose prowess all men stand in need; the accomplished man, whose knowledge all men require; the pleasant speaker, of whose eloquence all men are enamoured.

The rest of Abu 'Ali Maskúyeh's book is made up of similar collections of wise saws and maxims attributed to other ancient Persian kings. These, again, are followed by the sayings of the Arab philosophers, and the book concludes with an epitome of the dialectics of the Greek philosophers, arranged according to the common Arabic order, commencing with Hermes Trismegistus and ending with Aristotle.

In order to make the work more complete, the Persian translator has added a selection from the sayings of Mohammed and the Caliph 'Ali, the *hadíth*, or traditions on which the *sunnah*, or secondary law of the Mussulmans is based.

The Pehlevi archetype of Hosheng's book, if it ever existed elsewhere than in the imagination of Mamún's minister, is now irrecoverably lost; but whatever may be our decision upon the authenticity of his Testament, there can be no doubt that it really contains much of the proverbial philosophy of antiquity in the East. In their Arab form, the maxims remind us forcibly of the divine utterances of the Hebrew prophet and sage, the prince of all didactic teachers, Sulaimán ibn Dá'úd himself. Nor will the moral philosopher fail to recognize in many of them doctrines, such as

fatalism and asceticism, which are frequently considered as the peculiar consequence of Mohammedanism, but which are in reality the offspring of the innate tendencies of Oriental peoples. Asceticism in particular has ever been a prominent feature in the development of Eastern ethics; but, so far from being exclusively Mohammedan, the prophet emphatically declared himself adverse to it when he uttered the famous words, "there is no monkery in El Islám;" and yet, in spite of this edict, dervishes and recluses abound wherever the profession *La iláha illá alláh* is heard.

ON THE EFFECT OF THE RECENT HIGH TEMPERATURE UPON INSECT LIFE.*

BY E. C. RYE.

Despite the more recondite labours of our *savans* in Natural History, and apparently uninfluenced by the diffusion of knowledge through the many Magazines and popular Handbooks of all the 'ologies, a remnant of that old belief in the potency of the sun for vivifying "primordial germs" seems still, in a modified condition, to possess the public mind, if we are to accept the recent letters in the "Times" and other journals, concerning British Mosquitoes, as written in good faith. But, although newspaper Natural History may scarcely deserve serious remark, being in certain notorious instances too suggestive of a desire to obtain gratuitous advertisement on the part of the writer, and, in most others, of an implicit belief in the maxim, *omne ignotum pro magnifico*, on the part of the Editor (what Coleopterist does not remember,—and, remembering, smile at,—the fierce controversy in the "Thunderer," some few years ago, concerning our universally most abundant Brachelytrous insect, *Ocypus olens*, the "Devil's Coach Horse"?), still the endeavour, suggested by such trivial communications, to discover the real effect,—whether of development or retardation,—of unusually continuous high temperature upon insect life in an habitually damp and temperate country like ours, can hardly fail to be interesting, and may possibly produce results not unworthy of record.

An opportunity of observing this effect is now, or never, afforded to us; nearly four months of protracted heat, with no moisture in the air, and little or no rain, being assuredly more than our Insect Fauna has been hitherto accustomed to. We must remember, however, that

* This paper was written in the month of August. The Editor mentions this as some passages require that the date should be known.

heat is not the sole noticeable feature in those exotic regions wherein insects not only swarm specifically and individually, but assume eccentricities of size, development, and colour far in excess of those exhibited by their tamer Britannic brethren. To heat, excessive *moisture* must be added; and this is afforded by the regular alternation of dry and rainy seasons in tropical countries (save in such as the Egyptian and other African regions, in which rain seldom, if ever, falls, and which have an Insect Fauna adapted to their respective climatic peculiarities). To increase, therefore, the probability of any but temporary effects resulting from the very hot weather which we have recently endured, it would appear necessary that it should be followed by rains of sufficient volume or duration to restore the disturbed balance of moisture; and these, judging from the present condition of the weather, it seems not unlikely that we shall have.

Apart, however, from any inferences to be drawn from the combination of heat and moisture in other countries, and as immediately appreciable results of an excess of heat alone, I may mention:—

1. The temporary disappearance, and possibly (for a time) actual diminution in numbers of water-frequenting insects,—Coleopterous, Neuropterous, Hemipterous, or Dipterous. Such insects must necessarily be put to great straits in the perfect condition; and, in their earlier stages, are not unlikely (especially such of them as are carnivorous or normally pass a long time as larvæ) to become stunted or actually perish. When, as I was this morning informed, Windermere has sunk about three feet from its usual level, it is not to be wondered at if the hunter for water-insects and the collector of *Rotifers* and *Diatoms* should find their accustomed ponds converted into bare wastes, gaping with multitudinous chinks. It is an ill sun, however, that bakes nobody good; and the Coleopterist will, if he be just at the right time, in the scarcely damp residue of former depths, and under the unwonted cover of bricks, pots, and pans, find accumulated the living beetle tenants of the evaporated waters, an easy prey.

Similar desiccating influences have this season already had a corresponding effect, as far as my experience goes, on certain subcortical species. Last year, under the dry sheets of bark of a very old dead beech, I was fortunate enough to find, among several other good things, the doubtfully British *Brontes planatus*, in some numbers; and, not wishing (wisely, as I thought) to "kill the goose for the golden eggs," I left certain portions of the dry dead bark on the tree for future years. But the great heat has, I find,

entirely spoiled even these weather-dried retreats, so that not a beetle of any kind is to be found beneath them. It must be remembered, however, that such extreme heat would not injure subcortical species, as a class; for it would afford them fresh food by administering the *coûp de grace* to such trees as were struggling for existence in places where moisture is habitually scanty.

2. The immediate acceleration of metamorphosis of such species, chiefly terrestrial, as, by reason of their not normally passing a long time in their earlier stages, or otherwise, are capable of being hurried without injury. Very numerous instances, especially in the *Lepidoptera*, might be adduced of this; for instance, certain species of *Eupithecia* have been observed to be three weeks more in advance during this year, compared with the same species, under the same conditions, during former years; *Ennomos tiliaria*, usually found at the end of August or beginning of September, has been taken this year on July 13th, etc., etc. The larvæ of insects of this order are, however, well known to all breeders to possess a capability of "making hay while the sun shines,"—which instinctive talent probably induces them during very hot seasons to waste no time over their food-plant, which is very likely to wither unusually soon. Here, however, it may be remarked that increased temperature may suit the development of some plants; if so, then, any insect-feeders, taking their usual preliminary period, will derive benefit from increase to those plants.

A conspicuous result of acceleration is the increase of broods; such species as are here habitually single-brooded during the year becoming double-brooded, and these normally double-brooded becoming treble. It may be necessary to explain that the expression "single-brooded" is intended to signify insects that require the period of one year to complete their metamorphoses; such as those in which the egg is laid in the spring, the larva attains its full growth late in the summer, turning to pupa in the autumn, and the perfect insect is soon disclosed, and hybernates as such, or comes out in the ensuing spring, in either case then depositing its ova for the next year's brood. Modifications of this scheme occur, wherein the winter is passed by the insect, either as an egg or larva, instead of a pupa or imago. In those of more rapid growth two consecutive series of individuals undergo all their metamorphoses during one year. These habits of single and double brooding are retained, except when for a time deranged by external causes, but no sufficient reason appears for them, either from the rarity or the period of appearance of food-plant. As instances of an increase of brood in

individuals of certain species, usually single-brooded, I may mention the common "Poplar Hawk-moth" (*Smerinthus populi*) and the "Tiger" (*Arctia caja*), wherein the recent hot weather has excited a double action. I may here observe (without reference to these insects) that the members of an abnormal second brood are usually smaller, darker, and more suffused than those of the first brood. This is well instanced by certain species of *Ephyra*, belonging to the *Geometridæ*. And in cases where an abnormal third brood is expedited, such brood resembles the second, and does not revert to the type, or first brood, as it would if it remained in the pupa state during the winter.

That heat is the primary cause of this increase of broods is evident from the fact that species normally double on the Continent, are usually single here; and those normally double in the south of England, are single in the north; where, also, insects often remain longer in the pupal state. As an instance of acceleration in another order besides the *Lepidoptera*, I may remark that so early as the last week of June I found (when, in pursuit of beetles, investigating such a damp residue of a formerly large pond as I have above referred to) a great number of pupæ and pale, recently disclosed, perfect insects of *Philhydrus lividus*, a common aquatic clavicorn beetle. These, and numerous (if not all) other beetles in ordinary seasons, attain their last stage of metamorphosis late in the autumn, remaining mostly quiescent in their cells until the next spring.

Acceleration, when occurring, seems not unfrequently to be accompanied by an increase in the absolute number of individuals of certain species, which have been exposed for a shorter space of time than usual to their usual obnoxious or depressing influences. Already we see recorded the occurrence this year in great numbers of the rare "Pale-clouded Yellow" (*Colias Hyale*) at various parts of the kingdom, and several captures of the almost (Britannically) fabulous "Bath White" (*Pieris Daplidice*) and "Queen of Spain" (*Argynnis Lathonia*), with many of that very rare Hawk-moth, *Deilephila lineata* (sometimes erroneously called *D. livornica*—a species which does not occur in this country), and the rare *Sphinx convolvuli*, and more than one of the gigantic "Clifden Nonpariel" (*Catocala fraxini*). It must, however, be admitted that many insects, such as the "Painted Lady" (*Cynthia cardui*), both species of *Colias*, "Death's Head" (*Acherontia atropos*), "Humming Bird Hawk" (*Macroglossa stellatarum*), and others, occur at intervals in large numbers, often all over the kingdom; and that such occurrence seems from former records to be capable of being caused by some

other influence than excessive heat, however potent excessive heat may be when it does occur.

This year, at all events, the sun has shone to some purpose upon the plebeians as well as the aristocrats of the insect race, and seems to have considerably favoured the common large cabbage-white butterfly (*Pieris brassicæ*), which, on the disappearance of its ordinary cruciferous food-plant, through the continued drought, has betaken itself to the garden "Nasturtium" (*Tropæolum majus*), one of the *Balsaminaceæ*, whose acrid and succulent leaves seem much to its taste. I believe it does not require any climatic influence to drive this insect to the "Nasturtium;" but I have certainly never observed the fact before. Its usual little parasite, *Microgaster glomeratus*, finds out the larva equally as well as when upon cabbage. I have been much amused when remarking the apparently innocent but insidious way in which this minute Ichneumon fly deposits its eggs. It strolls about the leaf on which a lazy, recently moulted larva is reposing, and gradually gets close to the middle of the body of the latter, which it delicately feels with its antennæ. The first contact of these organs causes the larva to jerk himself strongly, whereupon the fly entirely ceases all motion, and appears busily engaged in investigating the leaf. Renewed antennal titillations, after a pause, are followed by gradually decreased movements on the part of the caterpillar, which becomes fatally contemptuous of the trifling annoyance. At this stage, the *Microgaster* carefully elevates the front of its body, so as to clamber up by the hairs, moderating, however, all its motions by those of its gigantic victim, and finally getting a firm hold with all its legs upon the body of the latter. This obtained, it ceases all movement for a time, but soon curves its body downwards, and, after repeated, but gentle thrusts, succeeds in perforating the outer skin, when it works more vigorously and deposits an egg securely. This done, it carefully withdraws its ovipositor, and remains quiescent—of course repeating the operation afterwards until its burthen is satisfactorily housed. The ultimate result—a mass of little yellow silky cocoons, grouped round or protruding from a caterpillar *in articulo mortis*,—must have been observed by almost every dweller in our suburbs.

3. An alteration of food-plant, and possible modification of habits, through the extinction, in the vicinity of any species, of its proper pabulum. Many plant-feeding insects, though usually attached to a peculiar tree or shrub, if that cannot be found, prefer eating a few others instead of starving; and some feed indiscriminately on many plants (the common little *Polygonum aviculare*

seeming not to come amiss to a great number of Lepidopterous larvæ), so that there is generally room for contingencies in this matter.

It is possibly owing to some difficulty in obtaining their usual marsh victims, that certain of our common gnats, of the genera *Culex*, *Anopheles*, etc., have during this summer received the vague brevet rank of "mosquito," above alluded to; though there can be no doubt that certain of the *Diptera* really are more pertinaceous and aggressive during warm weather. The "mosquito" cannot be said to exist specifically, though *phlebotomically* it has an entity. That word (varied by numerous inflexions), is applied all over the world to *any* fly, chiefly of the genera *Culex* and *Simulium*, that infests and bleeds mankind. It is, of course, impossible for such fragile and short-lived creatures as these delicate *Diptera* to be imported, or, of their own volition, come into this country in their perfect state; and, as in their earlier stages they live in stagnant pools, they could not then be brought here. Any one, however, who is not yet familiar with that "common object," the head of *Culex pipiens*, and will take the trouble to examine the neat case of surgical instruments comprised in its trophi, will readily see that one at least of our indigenous tormentors is fully equipped for predatorial purposes. We have another Dipterous bleeder, an exceeding minute creature, with black body, and milky wings, generally known, I believe, as the "midge." When driven frantic by hordes of these shrilly trumpeting atoms, in swampy places in the depths of the Black Wood, Perthshire, I have wondered what their habitual food might be; for the incurious Gäel (whose cuticle, moreover, from constant exposure, must be somewhat tough) never penetrates there, and the wandering Saxon but seldom.

In addition to these three immediate results of great heat, viz., temporary disappearance of aquatic and certain other species, acceleration of metamorphosis and its sequences, and alteration of of food-plant, above alluded to, there are others which may possibly occur, and the possibility of whose occurrence seems to me the more likely if an amount of moisture be vouchsafed to us sufficient to compensate for the great forcing power of heat which we have had. These results may not manifest themselves until next year, when the combination of influences will have had time to operate more fully, though some of them will probably be at once observed. But, when we consider what an exorbitant space of time is demanded by the most confident theorists of development for even minute progression in what are termed "species," under the most

favourable circumstances, it is evident that we shall not be justified in anticipating any appreciable effects from such comparatively moderate phenomena of temperature as are likely to occur in this country, beyond those of a temporary nature. The highest aim, however, of the Student of Natural History must be to reason from collected facts, and the correct observation and due appreciation of even such effects as these, must be of greater use than mere accurate discrimination of species, which are, after all, artificial.

As one of such results, I think we may with some plausibility anticipate the record of an unusual number of species new to the British lists. This effect, if it occur, would probably be due, for the most part, to the unusual conditions being favourable to the development, in unaccustomed numbers, of certain species already existing as true inhabitants of this country, but of such rarity as hitherto to have escaped observation. It is, however, always difficult to estimate correctly what value should be given to such records, for discoveries of this nature may not be owing so much to extraordinary climatic causes as to additional numbers of investigators, or even to an excess of acumen and energy in one or more of them. These favourable conditions would be indirect in the case of *Phytophaga*, through the increase in quantity or development (or both) of the food-plants, as above mentioned, but more direct in the case of sand-frequenting species (*Cicindelæ*, and insects of similar habits), through the evident suitability of the change to their ways of life. Of these sand insects, it seems to me that the well-known "Ant Lion" (*Myrmeleon formicarius*), not as yet observed in England, though common abroad, might now be looked for in certain of our southern districts (such as Bournemouth) with some chance of success.

Another likely result, and from the same causes, is the detection, for the first time here, of recognized Continental *forms* of species already known as indigenous. Such developments may be instanced by the present occurrence, in numbers, of the winged condition of *Velia*, hitherto of excessive rarity in that form with us. We have several species of *Coleoptera*, represented by what are considered on the Continent to be *varieties* of a type form not as yet observed in this country; and some of these type forms it would be very interesting to detect. It will also be interesting to note, if such developments as immediately show themselves (*e.g.*, the *Velia* above alluded to), be perpetuated in the same proportion, or whether they will again disappear. Unusual varieties and stunted forms are also not unlikely to occur, through compulsory change of food-plant and

the continuous necessity of rapid feeding on inadequate material, as above mentioned. If any such depauperized forms appear in next year's examples of species that are usually subject to variation, but always hitherto have reverted to their type after the winter's interval, it will be good evidence of the effect of external influences in a natural state. In confinement, collectors often (sometimes wilfully) breed both stunted and abnormally marked or coloured specimens. As an immediate effect of heat in alteration of appearance, I may observe that the "Clouded Yellow" (*Colias Edusa*) has been remarked to exhibit an unusual amount of iridescence on its wings in hot seasons.

A third interesting, and not unlikely, result is the extension of range of species hitherto locally restricted. This may arise either from the absolute increase of numbers, or, where there is no such increase, the probability of individuals being compelled, from extinction or insufficiency of their ordinary food, to abandon their former sedentary habits. Insects that are usually gregarious would necessarily have a better chance of this extension, as the foundation of a brood by any such wanderer would ensure the existence of at least some of the members of that brood. Already we see recorded the occurrence, at Birmingham, of *Colias Hyale*, usually a south-coast species, and of *Lycæna Corydon*, an inhabitant of chalky downs, in Hyde Park! A recent expedition to Ross-shire has also resulted in the discovery there of many unsuspected southern insects, and of a deficiency of boreal species. Coming in such a season as the present, this is noteworthy, though possibly such an unexpected distribution has hitherto only escaped record from a lack of observers in that part of the country.

Lastly, there is a probability of certain species not truly indigenous, but often accidentally introduced, obtaining a footing here. Our lists abound in the more hardy of such insects, which have already established themselves *en permanence;* such as *Trogosita mauritanica*, certain *Silvani* and *Nausibius*, *Gibbium*, *Mezium*, *Niptus*, *Lasioderma*, *Rhizopertha*, *Alphitobius* and allies, *Sitophilus*, *Callidium violaceum* and others; and there is no reason why others not so generally swallowed as British (I do not allude physically to such of the above as are flour-frequenters) should not obtain a further step of brevet rank, through being more often seen. *Trichodes*, *Lymexylum*, *Bostrychus*, and insects of the like category, might with advantage assert their claims by sacrificing a few of their individual members to the British Coleopterists in 1869. This year the already recorded, but somewhat dubious *Bruchus pisi* and *pectinicornis* and

Tomicus typographus have been captured at Guildford and Scarborough respectively in some numbers; and four examples of a Glow-worm (*Phosphænus hemipterus*) belonging to a genus new to us, but not uncommon in France and Germany, have been taken at Lewes, Sussex. Being apterous, this insect cannot have flown over, after the fashion of the gigantic *Calosoma*, not unfrequently found on our coasts (but of which puzzling far inland captures have been made). *Attagenus megatoma*, also, one of the cosmopolitan *Dermestidæ*, which has been detected almost everywhere *except* in Britain, has this year been taken on the wing in London. I have not, however, contrary to expectation, heard of the occurrence this year in England of the true "Blister-fly," *Lytta* (or *Cantharis*) *vesicatoria*, which at rare intervals has been observed here.

A list of all the non-Britannic, European, and of exotic insects of all orders that have been taken in this country would be interesting, as showing the great capability of distribution which their class possesses. They would for the most part be coleopterous, and of wood-feeding habits. I well remember, when first commencing the study of Entomology in early youth, the admiration and awe excited in my mind by the late Mr. Robertson, of Limehouse, whose business as a timber-merchant constantly occupied him at the docks, and who exhibited to me certain drawers of his cabinet devoted to the insects which he captured there from time to time *proprio manû*. The gigantic and resplendent *Buprestidæ*, *Longicornes*, etc., inspired, I fear, a contempt for such small deer as had fallen to my lot. These extravagant exotics seem, however, sometimes capable of settling down for a time in our colder latitudes; for a large *Lamia* (I think *L. dentator*) was, I believe, naturalized in a wood near Manchester some years ago, and examples of it were captured at intervals. I have not heard of its permanent establishment. If my memory be correct as to this insect being *L. dentator*, there would be the less to wonder at in its temporary acclimatization; for that species is North American, and anyone who has seen a box of North-American insects can hardly have failed to remark the preponderance of forms evidently closely allied to (some not specifically separable from) those found in this country, in spite of the occurrence of others of a type quite unknown to us.

I will conclude these notes with the renewed suggestion that observations on minute points of development or degradation, alteration of habit, or otherwise, both now and during the next year, should be more carefully than ever made by the student; since the immediate effects of the recent heat, however slight and temporary

they may be deemed, and however much they may have been anticipated from former experience, are still appreciable, and are the more valuable as exhibiting the direct operation of natural causes upon "species." No such season as this has occurred since the promulgation of the "natural selection" theory, and investigation is, therefore, doubly interesting. My own opinion is that, could we know all, we should most probably find the conditions of life so balanced that they are not to be deranged by temporary excess, either for good or evil, but I think it must be admitted that if the believers (and they are many) in that theory can prove as permanent any extra development or variation through the extra heat, they will have materially strengthened their cause. Should the summer of 1869 be as hot as that of 1868, it would, of course, materially increase the interest and necessity of accurate observations and record.

WHAT IS AN EGG?

No more profound or interesting question can be propounded than that which we have placed as the title of this paper—"What is an egg?" If we could really tell what an egg is, we should have unravelled some of the great secrets of the universe; and, if we had not reached the origin of life, we should, at any rate, have arrived at a just conception of the multiplications and variations of organic beings. What is an egg? The believer in specific distinctions as permanent, unchangable entities, would reply that each egg is an organism descended from a previous organism of the same kind, and capable of development, under favourable circumstances, into an egg-producing creature, the same, in all leading characters, as the first of the series which appeared. Whether eggs or egg-layers came first into existence has formed the theme of many a speculation. In this country, the average opinion of non-scientific men has undoubtedly been that every kind of creature was originally produced by sudden creation in a complete state, and that from their eggs all their descendants have sprung through the continuous repetition of the series—egg-maker, egg, egg-maker, egg, from one generation to the other, in unchangeable sequence. Scientific observers have discriminated between eggs and buds—the former owing their peculiar energies to the union of male and female elements, and the latter, when occurring in animals, more or less

resembling a vegetable sprout. Plants, as is well known, may be propagated by plant-eggs—that is, by true seeds in whose formation both sexes have joined their powers; or by buds, which are rudimentary repetitions of the one parent from which they spring. Bud propagation is not uncommon in the animal world. The common polyp buds off its young, as well as produces them at certain seasons by a sexual process; and the female aphis, or plant-louse, produces successive generations by a series of internal buds. For a long time the method of generation by eggs was supposed to be limited to certain creatures which visibly laid them; but by degrees one tribe of animals after another has been recognized as egg-making; and late researches have brought out the fact in relation to infusoria; thus, if we take a wide view of the meaning of the term "egg," as proposed by Quatrefages, we shall be disposed to admit Harvey's axiom, "*Omere vivum ex ovo,*" "Every living thing is from a germ."

In the interesting work of Quatrefages, entitled "Metamorphoses de l'Homme et des Animaux," * which Dr. Lawson has ably translated, we find this passage:—"All vegetable and animal germs, seeds, buds, bulbs, and eggs, have their origin in a few granules scarcely visible under the highest magnifying powers, or even a single vesicle, smaller than the point of the finest needle. Thus commence alike the elephant and the oak, the moss and the earthworm; and such is really the first appearance of what, at a later period, will become a man."

The great distinction between animals in their treatment of their eggs is, that some lay them, and then hatch them, or place them in situations where the sun's heat can have that effect; while others carry on the hatching or developing process within the recesses of their own organs. Mammalian creatures were formerly thought to stand aloof from egg-layers; but Von Baer discovered the mammalian egg, and it was found to have the same essential properties and structure as eggs of other kinds.

If we examine an ordinary egg, we find its germinal power to reside in a small portion, and that is emphatically *the egg,* the rest being material for its development or protection. The germinal vesicle, or germ cell, acted upon by sperm cells furnished by the male, gives rise to the true egg, which is of microscopic dimensions. "The human ovum is a body not more than $\frac{1}{200}$th of an inch in diameter—so minute, in fact, that we cannot form any estimate of

* "Metamorphoses of Man and the Lower Animals." By A. de Quatrefages. Translated by Henry Lawson, M.D. Hardwicke.

its weight or quantity of matter. Let us assume, what seems probable, that it weighs about $\frac{1}{10000}$th of a grain." * Now, only a part of this consists of formative material, and if we refer to the active portions of the egg, the power of producing, by the accretions of new matter and development, the peculiarities of structure which the adult animal exhibits, our minds utterly fail to conceive of the minuteness of the particles to which we must ascribe a special organizing and directing force. A portion of a body, of which the whole weighs only a ten thousandth part of a grain, determines the exact mode in which matter capable of becoming its pabulum, or food, shall be aggregated together to reproduce the image of the parents by whom the egg was formed and fertilized, not only in the general characters of external and internal organs, but in those minute particulars, so frequently transmitted, of form of feature, colour of hair, skin, and eyes, exact shape of fingers, special deformities, and so forth. The problem would be an astounding one, if we had to ascertain merely how the image and peculiarities of the immediate parent were reproduced; but it frequently happens that characteristics appear which belonged to remote ancestors, and it is difficult to resist the conclusion that the formative powers the egg derived from them resided in particular particles distinct from the particles tending to reproduce the parental aspects and properties. It is upon such ideas that Darwin has constructed his remarkable theory of hereditary transmission, to which we shall have further occasion to refer.

The researches of chemists, and especially of Berthelot, lead us to believe that when a particle of growing matter alters the character of the food materials with which it comes into contact, and builds them up into organic forms, the laws of chemical composition and decomposition, act as perfectly and as freely as they do in laboratory experiments. There is not what older inquirers on the subject fancied, a control or modification of chemical and physical forces by vital forces, or by one vital force. Vital forces cannot be distinguished from other forces, or exhibited in a separate form. Some power which we do not in the least understand, and to which the term "vital" may be given (if it does not mislead through association with erroneous theories), commences a series of actions upon surrounding matter, and the consequence is that particles previously belonging to dead matter, or to organisms destroyed in the process, and acting as dead matter, become portions of a living organism. Now, we know of no kind of force without matter, and

* Cyclopædia Anat. and Physiol. Ovum.

we have no means of separating matter from force. We do not know of any matter that exerts no force, and we have no means of ascertaining what matter *is*—only of observing what it does. The force or power which arranges matter into a living organism, operates by co-ordinating chemical and physical forces to do the work, and as they do it they act as freely as if no life existed. By imitating the chemical and physical conditions which obtain in living bodies, we can make many of the substances which were formerly supposed to be produced exclusively under the influence of an assumed "vital force."

The mystery of life is quite insoluble with our present opportunities and faculties. If asked what it is, we look to the phenomena of living beings, and select those which are common to all living beings, and thus we get at its general properties—but, as to its essence, and the mode in which it operates, we are in perfect and apparently hopeless darkness. If the belief of the Heterogenists could be proved correct, and under certain conditions we could start a new living being without the intervention of any egg or germ formed by a pre-existing being, we should not understand much more than we do now. Why life appeared, and what it was in its essence, would remain quite as unknown as it is, now that the great mass of philosophers regard all existing life as the descendant and heir of life that previously had its being.

Let us consider what an egg—a mammalian egg, for example—has to do. The egg itself may be resolved by the microscope into a multitude of minute particles to which the term *cell* may be applied, provided that it is used in a very wide sense to designate any minute aggregation of germinal matter capable of growth and multiplication. As extraneous matter is operated upon and brought within the vital circle, particle is added to particle, or cell to cell, by a particular method of development. The original cells grow, and bud off smaller cells, which repeat the process, and thus distinguish organic growth from the gradual additions of molecule to molecule which takes place in crystallization. In the enlargement of a crystal there is no *growth* in the organic sense of the term. The small crystal in becoming a large one, attracts and puts in their right place particles of the same volume and composition as itself. In organic growth, a germ or cell takes in and effects changes in the composition of its food material; it enlarges itself and throws out offspring cells—its children—capable of repeating what the mother cell has performed. In the crystal the problem is the simple one of aggregating molecules of a given material in a certain form,

or if in more forms than one, then into such forms only as belong to the same geometrical series, and are, so to speak, modifications of the same geometrical idea. Snow-crystals, for example, exhibit a beautiful variety of *patterns*, but all made up of prisms united at angles of 60°. The egg of a mammal has to arrange fresh particles, so that they shall gradually build up a number of tissues and organs exhibiting great variety in form and structure. The eye, the lungs, the brain, the heart, the apparatus for digestion and circulation, all have to be formed by the development of parts which at first are quite indistinguishable from each other, and which in their earlier stages give no indication of their ultimate tendencies and results. No microscopic powers can resolve the contents of an embryo cell into parts recognizable as the parents of the particular organs which are to result from their development, but at a certain stage of egg-growth the physiologist guided by experience can point to portions of the organism which will undergo special developments and give rise to special organs.

In invertebrate animals, the blastoderm, which literally means "germ-skin," developes into a single investment, which encloses all the viscera; "but in the five vertebrate classes, the parietal portion of the blastoderm of the embryo always becomes raised up, upon each side of the middle line, into a ridge, so that a long groove is formed between the parallel ridges thus developed, and the margins of these eventually uniting with one another constitute a second wall parallel with the first, by a modification of the inner walls of which the vertebrate cerebro-spinal nervous centres are developed." *

If we compare the invertebrate with the vertebrate egg, we find the outer layer, or "derm," of the latter has inherited the power of making two tubes, or divisions, for the growing animal—one to hold its viscera, and the other to contain its brain and spinal cord; while the outer layer of the former has only inherited the power of forming one such tubular division. We can see nothing in the particles of the two blastoderms to indicate that they would possess such properties, nor can the particles of the vertebrate blastoderm which make one tube, well be distinguished, except by their position and their action, from the particles which make the other tube. Nor can granules which are to grow into organs be distinguished from each other. It is evident that the powers of organization possessed by the particles of the egg are inherited from the female creature that made the egg, and from the male which fertilized it. But how

* Huxley's "Elements of Comparative Anatomy."

are the powers transmitted? Does each particle owe its own power to a similar particle in the parental organism? Are the particles of the mammalian blastoderm, for example, which undertakes the formation of what is to grow into skull and backbone, the lineal descendants of particles which made up those portions of the parent form? When the rudimentary head appears, and the rudimentary eye can be distinguished, are these organs lineal descendants of the head and eye of the parent? If it be so, Darwin's "Pangenesis" is true philosophy, however astounding it may appear. Darwin suggests that "the child, strictly speaking, does not grow into the man, but includes germs which slowly and successively become developed, and form the man. In the child, as well as in the adult, each part generates the same part for the next generation." * If this theory is to be associated, as in Darwin's remarkable speculations, with the doctrine of development, and the probable origin of all species from a few, if not from a single primordial form, whenever an advance, or a change in organization, took place, the egg particles which the advanced or changed creature formed must have inherited the faculty of reproducing the modifications, as well as that of being susceptible of still further variation.

The egg problem is much more complicated than it is represented in the inquiry of how it is that eggs reproduce parental characters. What is called "Atavism" is the tendency to reproduce the peculiarities of an ancestor more or less remote. When a variety is obtained from plants or animals, the tendency to go back to the original pattern is well known; and a variety must be reproduced for several, or sometimes for many generations, before it becomes fixed. Even in the case of domestic animals descended ages ago from a wild stock, the disposition to go back to the original type is frequently observed; and such facts would seem to show that a tendency to revert to ancestral form may be universal, and that where such reversion does not take place, it is counteracted by the stronger tendency to repeat that of the immediate parents, with slight variations. But whatever tendencies exist of this kind must be inherited, or must result from an accidental repetition of circumstances and conditions affecting development in a particular way.

When an animal of normal structure, and in good health, forms an egg which developes into an embryo capable of growing into the likeness of its parent, the phenomenon, though quite as wonderful, is less striking, than when an egg is invested with the power of

* "Animals and Plants under Domestication," vol. ii., p. 404.

reproducing peculiarities that cannot be accounted for by arrest in development of a normal egg. Darwin cites the case of a cow that lost a horn by accident, with consequent suppuration; and who gave birth to three calves, hornless on the same side of the head; and, on the authority of Blumenbach, another case of a man "who had the little finger of the right hand almost cut off, and which in consequence grew crooked; and his sons had the same finger on the same hand similarly crooked." Similar incidents have occurred within the observation of most families, and are extremely puzzling whichever way they are regarded. If we accept Darwin's "Pangenesis," we must suppose some of the finger germs altered their condition after the accident mentioned. Before the damage done to the finger, the father's contribution of finger-particles to the mammalian egg would have led to the customary formation, but after it they carried with them the disposition to an altered shape. It is easy to say that such a supposition is improbable; that properties are ascribed by it to particles quite inconceivable from their minuteness; and that, in such cases as these, the older idea that the imagination of the mother influenced the character of the germ and its development is more believable. It may be so; but no maternal imagination can persuade a pigeon to lay an egg that developes into a bird partially resembling an ancestor she never saw; and we come at last to the conclusion that eggs must have in them forces which correspond with all their peculiarities of development; and as we cannot conceive those forces to exist except as properties of matter, we must imagine that the germinal matter of the egg, simple as it appears, does in some way actually or potentially contain particles which represent all the parts and organs that are to arise. In the Pangenesis theory, "an animal does not, as a whole, generate its kind through the sole agency of the reproductive system, but each separate cell generates its kind;" * and "all organic beings include many dormant gemmules derived from their grand-parents, and more remote progenitors, but not from all their progenitors." † How many germs an egg must contain, according to this view of its nature, will depend upon the specific distinction, if we may use the term, existing between cell and cell in any given organism. It is only necessary that there should be as many kinds of cells as there are distinct centres of growth in the egg. One growth determines another; the direction of two growths will determine the direction of a third, and so forth. The problem is evidently very

* "Animals and Plants under Domestication," vol. ii., p. 403.

† Ibid, p. 402.

complicated, but we do not know how complicated, and we may ultimately find it resolvable into simpler elements than now appear. Naturalists observe that certain formations are linked together in a manner that suggests some community of cause; and a whole series of growths may be determined by an incident common to all in their origin. Without much more information, we do not know how the Pangenesis theory stands between the two poles of probability and improbability. Few would venture to pronounce it impossible, and those who think it improbable would do well to consider by what more probable theory it could be replaced. Whether right or wrong, it has the true character of a scientific hypothesis—it stimulates thought and directs inquiry. It may not answer our question, "What is an Egg?" but it certainly helps us to understand the nature of the problem of which we want a solution, and it suggests lines of investigation which may bring us to the truth.

ASTRONOMICAL NOTES FOR OCTOBER.

BY W. T. LYNN, B.A., F.R.A.S.

Of the Royal Observatory, Greenwich.

Mercury will be at his greatest elongation on the morning of the 13th; but as his declination is considerably southern, he will set within half an hour of sunset throughout the month. Venus continues a morning star. Mars will not rise until past eleven o'clock, and will therefore, not attain any considerable altitude until some time after midnight. He will be situated in Cancer. Saturn will be visible only in the early hours of the evening, and then very low in the heavens.

Jupiter will consequently be the only planet which will be conspicuous in the sky in the first half of the night during the month of October. At its commencement, he will rise about half-past five, and at the end, about half-past three in the afternoon. He will be on the meridian at eleven o'clock on the 13th day, and at ten o'clock on the 27th. On the evening of the 1st day, and again on that of the 28th, he will be very near the Moon.

Phenomena.—We again select from the "Nautical Almanac" a list of those phenomena of Jupiter's satellites which will be observable at convenient hours of the night:—

DATE.	SATELLITE.	PHENOMENON.	MEAN TIME.
			h. m.
October 1...	II.........	Transit, ingress	8 38
" 1...	II.........	Transit, egress	11 4
" 1...	I.........	Transit, ingress	12 1
" 2...	I.........	Occultation, disappearance ...	9 11
" 2...	I.........	Eclipse, reappearance	11 24
" 3...	I.........	Transit, egress	8 40
" 6...	III.........	Occultation, disappearance ...	10 41
" 8...	II.........	Transit, ingress	10 54
" 9...	I.........	Occultation, disappearance ...	10 55
" 10...	I.........	Transit, ingress	8 10
" 10...	II.........	Eclipse, reappearance	8 29
" 10...	I.........	Transit, egress	10 23
" 11...	I.........	Eclipse, reappearance	7 48
" 16...	I.........	Occultation, disappearance ...	12 39
" 17...	III.........	Transit, egress	6 26
" 17...	II.........	Occultation, disappearance ...	7 49
" 17...	I.........	Transit, ingress	9 53
" 17...	II.........	Eclipse, reappearance	11 4
" 17...	I.........	Transit, egress	12 7
" 18...	I.........	Occultation, disappearance ...	7 5
" 18...	I.........	Eclipse, reappearance	9 43
" 19...	I.........	Transit, egress	6 33
" 24...	III.........	Transit, ingress	7 4
" 24...	III.........	Transit, egress	9 47
" 24...	II.........	Occultation, disappearance ...	10 4
" 24...	I.........	Transit, ingress	11 38
" 25...	I.........	Occultation, disappearance ...	8 50
" 25...	I.........	Eclipse, reappearance	11 39
" 26...	I.........	Transit, ingress	6 4
" 26...	II.........	Transit, egress	7 4
" 26...	I.........	Transit, egress	8 18
" 27...	I.........	Eclipse, reappearance	6 8
" 31...	III.........	Transit, ingress	10 25
" 31...	II.........	Occultation, disappearance ...	12 20

The disappearances at eclipse are not visible throughout the month, the satellites being still behind Jupiter when they enter his shadow; the reappearances take place at a small distance to the right of the planet, as seen in an inverting telescope. No eclipse or other phenomenon of the fourth satellite will take place.

No occultation of any star of considerable magnitude by the Moon will occur within the earlier hours of the night.

New Planet.—We have now entered on the second hundred of the minor planets, Professor Watson having detected the 101st on the 16th of August last. As this is the sixth discovery of the kind this year, the number of members of the group visible to our telescopes seems to be by no means yet exhausted. We may mention that the hundredth was, after him, independently discovered by Peters at Clinton, N.Y., and also, later still, by the French observers at Marseilles.

Encke's Comet.—Professor D'Arrest was the first to detect this interesting body on the 20th of July, at Copenhagen. It was excessively faint, and about 45″ in diameter. The right ascension was about 16 seconds less than that assigned by the ephemeris, whilst its error in polar distance was very small. Professor Karlinski made several observations at Cracow, the first of them being on July 24: they were however very uncertain, owing to the great faintness of the object. Becker also observed it at Berlin until August 25. For further observations of this comet at its present return, we must look to the southern hemisphere, where it will probably be visible to large telescopes during this month and a part of November. It passed its perihelion on the 15th of September. As it would seem to be undergoing the process of dispersion, from the feeble cohesion of its parts, one is inclined to doubt whether there is much likelihood of its being seen at all at future returns. D'Arrest calls attention* to a similar remark, made some years ago, in a letter from Pape to himself in reference to Faye's comet. The idea, however, is far from new, although recent facts have imparted additional importance to it.

The Moon.—Two Full Moons occur this month—at 7h. 58m. P.M. on the 1st day, and at 11h. 5m. A.M. on the 31st. The conjunction is at 11h. 1m. on the night of the 15th. From the 19th, therefore, till towards the end of the month will be the best period for studying the objects on the lunar surface, as the advancing terminator passes successively over them. The first quarter is on the 23rd, at 9h. 42m. A.M. The Mare Serenitatis will be in view on the 21st. The interest which has attached to the crater Linné in this Mare has not yet passed away; and, assuredly, no spot on the Moon has yet been subject to such frequent and continued scrutiny. We may hope, at last, for some acknowledged results of value; for if even one actual change upon the Moon's surface be well authen-

* "Astronomische Nachrichten," vol. lxxii., p. 309.

ticated, lunar physics will at once become a most important object of scientific research. We find, however, at the late Meeting of the British Association, Professor Mädler (upon the supposed difference in whose description of Linné in "Der Mond," and its appearance recently, the theory of a great change in it has been principally founded) stating, in a paper read by him there, that, on the 10th of May, 1867, he observed it at Bonn, and "found it shaped exactly, and with the same throw of shadow, as he remembered to have seen it in 1831" (when the observations for "Der Mond" were made). The reflection he makes upon this is, "The event, of whatever nature it may have been, must have passed away without leaving any trace observable by me."

The August Eclipse.—At the time of our writing, three telegrams are the only source of communication from India on this subject. Two of these are noticed in the miscellaneous Notes at the end of the last number of The Student. It is satisfactory to learn from them, and from a subsequent one received from Lieutenant Herschel, that the observations were, although not uninterrupted by clouds, to a great extent successful. But we are compelled to reserve any account of the results until our next.

The Nature and Orbits of Meteoric Showers.—So interesting a paper on this subject has lately been communicated by Dr. Edmund Weiss to the Vienna Academy, that we deem it to form a necessary part of our plan to give a somewhat full account of it. In the 11th Volume of the "Intellectual Observer" (for June, 1867), page 390, we gave a *résumé* of the then state of our knowledge, as bearing upon the theory of the connection which appeared to exist, in some way not perfectly understood, between comets and shooting-stars. We shall take the opportunity now afforded to furnish our readers with some further facts which have been discovered or adduced in reference to it.

To Signor G. V. Schiaparelli, of Milan, belongs the undisputed priority in calling attention to the curiously close resemblance of orbit between certain comets and showers of meteors which have been proved to be periodic. This identity of orbit being shown to exist between the Perseides, or August meteors, and Comet III., 1862, and also between the Leonides, or November meteors, and Comet I., 1866, was made by him the foundation of a theory that the meteors consisted of cosmical collections of nebulous material of so loose a constitution, that, on coming within the sphere of attraction of the Sun, they are drawn into parabolic streams of great length: whilst the more condensed parts of them appear to us,

when near perihelion, under the form of comets. However well this theory appears to be supported by the fact of several identities of the kind in question (the detection of which must be allowed to mark an epoch in astronomy), yet its reception, it is remarked by Dr. Weiss in the paper before us, is exposed to an objection of very considerable weight. For the masses of matter of which the showers of meteors are formed appear, with the exception of perhaps one or two particular cases, to consist collectively of such small amounts, that, even in regions beyond our own or any other solar system, the internal mutual attraction of the parts of the congeries composing any one of them must be exceeded by the scattering effects produced by the nearer fixed stars. It is scarcely possible, therefore, that such a collection of materials, the conversion of which into parabolic chains by the Sun's attraction produces, according to Schiaparelli's theory, meteoric showers, should exist even in the depths of space; since it would not possess the requisite stability. "We must, therefore, consider comets, not as integral parts of a swarm of meteors, but rather as the originating bodies, the dispersion of which, when *within* our solar system, gradually forms the meteoric showers. This hypothesis is favoured by the examples of identity of orbit (mentioned above) brought forward by Schiaparelli himself; for they both are concerned with periodic comets, and it is now, I believe, generally allowed that comets are not original members of our system, but only casual visitors, excepting when the attraction of one of the planets, by converting the orbit of any one into an ellipse, retains it, at least for a time, in the system."

Dr. Weiss had previously proposed the calculation of the apparent radiant-points for those cometary orbits which approach very near the earth's orbit at either ascending or descending nodes, and the comparison of these with the observed radiant-points of meteors, as a means of discovering which of the comets stand in connection with the different meteoric showers. He had also shown that, on nearly all the days which have been remarked as affording repeated displays of shooting-stars, one or even more cometary orbits crosses the earth's orbit near the then place of the earth. In the paper we are now referring to, he gives the results of a complete calculation of the radiant-points of all the cometary orbits which have been well determined, and either node of which is at very nearly the same distance from the Sun with the Earth. Two only of these agree with observed radiant-points of meteors sufficiently closely to indicate a very probable connection; that of Comet I., 1861, and that

of Biela's comet. The former agrees very nearly with that of the April meteors, as had been also pointed out by Dr. Galle, and to which we called attention in the April number of The Student.

The agreement however, although speaking strongly for some physical connection, is not sufficiently great to admit of the differences being explained by error in the determination of the observed radiant. Dr. Weiss conjectures that it may be due to the separation of some large comet, near the place of its crossing the earth's orbit, into two or more fragments, one of which only is at present known to us. This, since the division of Biela's comet, and Hoek's remarks on cometary systems, cannot in itself be considered improbable, and is further supported by one or two other circumstances. The form of the comet's head was very remarkable, and gave the idea of a very feeble connection with the coma; the rich displays of shooting-stars about the 20th of April, collected by Professor Newton, point to several cometary-like condensations in the interior of the ring, since they can hardly be ascribed to returns of one and the same dense part of it, without assuming a very improbably short periodic time; and another meteoric shower has been detected, appearing on the 12th and 13th of April (radiant R.A. 273°·0, N.P.D. 64°·5), showing, when reduced to calculation, that at least more than one ring of meteors does, in fact, exist in that place with very similar elements of orbit. With regard to Biela's comet, it had been also remarked by Professor d'Arrest that the earth passed through its orbit at a time when, at the beginning of December, showers of shooting-stars had frequently been seen.* It appeared on calculation that the radiant-point, as determined by Heis, Greg, and others, agreed very well with the supposition of their connection with this comet. The latter had a rapid retrograde motion of the nodes; and by calculating the radiant-points deducible from its position at different appearances, we should be led to a meteoric ring shifting very quickly its apparent place in the heavens and the epoch of its return. Dr. Weiss remarks that it would be exceedingly interesting if some physical astronomer would calculate for these meteors, as Professor Adams has so completely done for the November shower,† the secular variation of the longitude of the node caused by the planetary perturbations. It had not escaped D'Arrest that the two great meteoric displays of 1798 and 1838 were separated from each other by an interval of time just equal to six periods of Biela's comet. "Under these circumstances,"

* See "Intellectual Observer," vol. xi., p. 391.

† "Monthly Notices of R. A. S.," vol. xxvii., p. 247.

observes Weiss, "another fact is the more remarkable. The elements deduced by Pogson (from uncertain observations indeed), of the comet of 1818, have a great resemblance to those of Biela's; the two comets cannot, however, be identical, on account of the epoch of the perihelion passage. But if we assign to the former the periodic time of the latter, two perihelion passages will occur (of course six periods apart) in 1798·2 and 1838·2. Is this merely casual? Or is it not more probable that, besides Biela's comet, another, which formerly separated itself from it, moves in the same orbit; and that there is, connected with this, a proportionately very dense part of the meteoric ring, similarly as was the case with Comets III., 1862, and I., 1866, the passages of which through the descending nodes of their orbits were doubtless the causes of the rich showers of shooting-stars in the years 1863 and 1866?"

There are several other points in Dr. Weiss's paper deserving of notice, but as his other investigations into cometary and meteoric orbits have not conducted him to any certain results, we will content ourselves with translating those parts of it* which relate to the heights and velocities of meteors.

"There is now no longer any doubt that the luminous appearances which are seen in displays of shooting-stars, arise entirely from the resistance of our own atmosphere, although we have not yet succeeded in explaining thereby all the peculiarities of the phenomenon. The elevation, therefore, at which they become luminous, and are afterwards extinguished, must depend, not only upon their size and chemical nature, but also upon the velocity with which they penetrate into the atmosphere. The latter element is, of course, different for different showers only, whilst the first and probably the second also vary in different meteors of one and the same shower. Nevertheless, it has been found, in the richer showers, that the greater part of the meteors possess nearly the same degree of luminosity, which seems to point to the conclusions that for any particular shower a nearly constant magnitude and chemical constitution prevails in the meteoric particles of which it is composed, and that, moreover, when the mean for several such particles is taken, the height at which they appear and disappear is nearly invariable.

"If we calculate the influence of velocity upon the height at which the appearance and disappearance of luminous meteors take place, neglecting the effect of the curvature of their orbit and the accelerating force of the Earth's attraction within the atmosphere,

* "Astronomische Nachrichten," No. 1710-11.

and form different plausible assumptions concerning the resistance of that medium and the diminution of its density outwards, we shall arrive at the interesting result that, even in the most exterior and least dense strata of air, the atmospheric resistance will very rapidly diminish the original velocity with which the meteors entered it; and under nearly similar circumstances all meteors will be extinguished at nearly the same height above the earth's surface, with whatever velocity they may have approached it. In actual fact, however, the matter is far otherwise. By means of the friction with the aërial molecules, the glowing particles on the surface of the meteors are rubbed off, and this to the greater degree the greater the friction is, and therefore according to the rapidity of the motion. In this way alone would the more rapidly-moving meteors be annihilated earlier than those of slower motion; but in addition to this, they became luminous at greater heights, because owing to their velocity, the action of a smaller amount of retarding power upon them is sufficient to generate the force requisite to produce luminosity. The quicker meteors will therefore appear and disappear at greater elevations than the slower; they will be accompanied by larger trains, and also shine much more intensely, because they not only possess a larger supply of *vis viva*, but this is, supposing the track to be about the same, more quickly exhausted by reason of the more rapid motion. Thus is suggested a simple explanation of the phenomenon, formerly so enigmatical, that the meteors which move with the greatest velocity are usually those at the greatest distance.

"This circumstance was not long since specially called attention to by Newton, in reference to the periodic August and November meteors. The latter appear and disappear at much greater altitudes above the earth's surface than the former, and for the most part shine with a much more intense brilliancy, and are much more usually accompanied by trains; the principal cause of all which phenomena is to be sought in the fact, that the velocity with which the November meteors penetrate into the Earth's atmosphere is much more considerable than in the case of the Perseides, although molecular differences may also have a share in producing them.

"I consider then, that the present state of our science calls upon us to be no longer content with determining merely the mean height of the appearance and disappearance of shooting-stars in general, but rather to aim at the knowledge of those heights for the different meteoric showers severally, as we now seem to be in a position to do with advantage. I have even endeavoured to make a beginning

of this kind by putting together the existing determinations of elevation compared with the radiant-points; but very soon convinced myself that the European observations hitherto made are, in the case of the Perseides alone, sufficiently numerous to lead to a result of tolerable certainty. For in order to decide whether a corresponding observation is or is not available for the determination of height, we have, besides the known and ordinarily employed characteristics, another and a very simple criterion, but which has never yet, so far as I am aware, been properly applied. This is the investigation, whether the two meteoric paths, as recorded at two stations, tend, when prolonged backwards, to nearly the same point in the heavens (the radiant-point). This investigation, which is quite indispensable if it be desired to put together the heights at the beginning and end of the observed paths for the different meteoric showers, or radiant-points, ought indeed never to be omitted. If it was always carried out, not only very much labour would be spared, but also many results would be avoided such as have too often given occasion, by reason of their supposed reliability, to the most erroneous notions with regard to the course, luminosity, etc., of meteors. To give but one striking example of this, I will mention the shooting-star observed on the 9th of October, 1798, between Clausberg and Sesebuhl, by Brandes and Benzenberg, which 'went straight up like a rocket,' and was long regarded as a proof of the existence of ascending shooting-stars. But if we map down the paths assigned by the observations, we shall find that that recorded at the one place, when prolonged forwards, cuts that recorded at the other place nearly at right angles; which proves at once that either the observations are affected by some error which renders them quite useless, or the two meteors, considered to be identical, are in reality different ones."

After some further remarks on this subject, Dr. Weiss states that he has investigated in all 139 complete European observations of the August shooting-stars. Of these, 25 belong to other radiant-points than the known one in Perseus; in 65 others, the radiant-point is either quite unrecognizable in consequence of errors of observation, or is situated only for the one station in Perseus, whilst the path recorded at the other station tends to a different part of the heavens; the remaining 49 only are Perseides (radiant-point R. A. 44°, N. P. D. 34°) so well observed at both stations that confidence can be placed in the calculated heights. Professor Newton had concluded from his own investigations that in none of the shooting-stars was the middle of the luminous path at a greater elevation

than 112 English miles. Dr. Weiss believes himself able to go farther, and assert that even the beginning of the luminous paths of the August meteors has in no instance exceeded, or even reached, this limit. As a mean from all the 49 observations, he has found the height of the Perseides to be, at appearance or beginning of path, 71·2, and at disappearance or end of path, 54·6, English miles. This agrees very closely with the result derived by Newton, in America, from 39 determinations on the night of the 10th of August, 1863, which gave 69·9 and 56·0 miles as the mean of the heights at appearance and disappearance respectively.

Dr. Weiss concludes his paper with the remark, that in several of the series of observations, the duration of visibility, as well as the length of the path has been recorded. Of these, 12 only appeared sufficiently reliable for a determination of velocity; the resulting mean velocity being 30·9 miles per second, somewhat less (as the resistance of the air would lead us to expect) than that obtained from theory, which amounts to 37·1 miles per second. It is exceedingly desirable that practised observers would as frequently as possible determine this element of meteoric motion, as it would lead, when well established, to very interesting consequences. To a person accustomed to astronomical observations, this will offer no difficulty whatever; others not so accustomed may easily, by a little practice, habituate themselves to counting seconds almost mechanically.

THE PROBLEMS OF FLIGHT.

The Aeronautical Society has done good work amongst thinkers by directing scientific consideration to the problems of flight. Projects for flying have been innumerable, and for the most part ridiculous, because not founded upon any accurate conceptions of the work to be done, and the force requisite for its performance. On the other hand, those who have denounced all schemes for enabling man to imitate the bird, have known scarcely more than the impracticable projectors of the mechanical conditions on which flight depends. Mr. Wenham was, we believe, the first scientific man who approached the question in a thoroughly practical way, and we had occasion to notice his labours in "The Intellectual Observer." He demonstrated that birds did not in flying exert the prodigious force usually ascribed to them, and he showed how, when they had once

risen in the air and acquired a horizontal motion, they could sustain themselves by a very moderate exertion. Many other most important considerations were adduced by Mr. Wenham, for which we refer our readers to our remarks at the time, or to the paper itself, published in the first Report of the Aeronautical Society.

We have now before us the Report of the first exhibition of the same Society, held at the Crystal Palace in the month of June, and we find some curious matter in the description of the various engines exhibited. Steam engines have usually been considered as quite inapplicable to any possible flying machine, on account of the high relation their weight bears to their power. But what are we to say of an engine weighing only sixteen lbs., and being able to work to one horse power? The council of the Society voted their £100 prize to Mr. Stringfellow for an engine of this description; and whether or not it ever becomes the motive power for flight, it would seem, from its ingenuity, to be well worth the reward. "The cylinder," the report tells us, "is 2 inches in diameter, stroke 3 inches, and works with a boiler pressure of 100 lbs. to the square inch; the engine working 300 revolutions per minute. The time of getting up the steam was noted; in three minutes after lighting the fire the pressure was 30 lbs.; in five minutes, 50 lbs.; and in seven minutes there was the full working pressure of 100 lbs. When started, the engine had a fair amount of duty to perform in driving two 4-bladed screw propellers, 3 feet in diameter, at 300 revolutions a minute."

"The data for calculating the power are taken as follows:—Area of piston, 3 inches; pressure in cylinder, 80 lbs. per square inch; length of stroke, 3 inches; velocity of piston, 150 feet per minute; $3 \times 80 \times 150 = 36{,}000$ foot-pounds. This makes rather more than one horse power (which is reckoned at 33,000 foot-pounds). The weight of the engine and boiler was only 13 lbs., and it is probably the lightest steam engine that has ever been constructed. The engine, boiler, car, and propeller together were afterwards weighed, but without water and fuel, and were found to be 16 lbs."

A highly-finished model in aluminium of an engine driving superposed screws was exhibited by Viscount D'Amecourt, but no demonstration was given of its powers. The method of flight by superimposed pinions—or wings—was suggested by Mr. Wenham, in consequence of his observing how close to each other the pelicans on the Nile could find room for the small motion of their wings necessary to sustain their heavy bodies in the air.

Mr. Quatermain exhibited a machine worked with a rocket

composition; and Mr. Philips showed "a working model of an aerial machine, raising and sustaining itself in the air for several minutes; being worked by a power evolved by the combustion of materials similar to those used in the original fire annihilator." Mr. Charles Spencer exhibited a pair of wings, by means of which, after a preliminary run, he could take "short flights to the extent of 100 feet."

Feats of this kind tend to modify opinions hitherto held on the subject of flight. In the first place we may hope for much larger powers in proportion to the weight of machinery than was conceived possible a short while ago. Aluminium and its compounds offer wonderful advantages in constructions of this kind, and thin tubular boilers, as in Mr. Stringfellow's experiments, unite the qualities of lightness and strength.

Dr. Fox, of Scarborough, has translated an instructive paper written by M. de Lucy, of Paris, "On the Flight of Birds, of Bats, and of Insects, in reference to the subject of aerial locomotion; in which it is stated, as the result of numerous investigations, that in flying animals the extent of winged surface is always in inverse ratio to the weight of the creature. He compares gnats, dragon-flies large and small, ladybirds, daddy-longlegs, bees, marsh-flies, drones, cockchafers, stag-beetles, and rhinoceros-beetles together, and arrives at the following highly interesting and unexpected results. The gnat, which weighs 460 times less than the stag-beetle, has 14 times more of (proportional) surface. The ladybird weighs 150 times less than the stag-beetle, and possesses 5 times more of surface, etc.; and it is the same with birds. The sparrow weighs about 10 times less than the pigeon, and has twice as much surface. The pigeon weighs about 8 times less than the stork, and has twice as much surface. The sparrow weighs 339 times less than the Australian crane, and possesses 7 times more surface. If we now compare the insects and the birds, the gradation will become even more striking. The gnat, for example, weighs 97,000 times less than the pigeon, and has 40 times more surface; it weighs 3 million times less than the Australian crane, and possesses 140 times more surface."

M. Lucy is quite entitled to laugh at the mathematicians when they make their calculations without sufficient data, and, like Borelli, assume that a goose exerted in its flight a force of 400 horse power! "Coulomb," he says (1780), "calculated that in order to support a man, it would be necessary to have a surface of 12,789 feet 2 inches in length, by 191 feet 10 inches in breadth, but we

now know that a man can easily descend from a very great elevation under a surface of 29 square yards 8 feet 14 inches."

All questions of mechanics are capable of mathematical solutions, provided they do not exceed certain limits in complexity, and provided also that all the requisite data are ascertained. Flying schemes by the hundred would be overthrown directly they were examined upon mathematical principles, but the actual problems of flight practically solved by birds, insects, and mammals, have not yet been fairly brought within the domain of mathematics, because sufficient information had not been collected for the calculator to work upon.

Without allowing a hopeful credulity to influence our speculations, we think the *possibility* of aerial locomotion by flying machines capable of sustaining great weights, will be admitted by most persons who will frankly consider such facts as have now been adduced. It is certain that birds fly with much less exertion of force than was supposed. It is clear that the method of superimposed planes may relieve inventors of much difficulty in construction, as they do not demand the strength of materials for widely extended fans. It is also shown that small engines of little weight can be made to work with a power immensely greater than had been previously obtained by the employment of small masses of matter. Lastly it has been demonstrated that large heavy birds can be sustained in the air in rapid flight by wings small in proportion to those with which nature supplies lighter and smaller birds.

Whatever may be the result of future experiments, it is satisfactory to know that in London and in Paris, men of real science have at last given their attention to a problem which can only be solved or proved insoluble by cooperation, and by a strict adhesion to experimental methods. The mathematician can tell unerringly what must happen under given conditions, but he cannot anticipate all the conditions which invention may devise, and while no sane aeronaut would construct his apparatus in defiance of well known laws, he is entitled to set aside, as irrelevant, all computations which are founded upon assumptions not ascertained to be correct.

THE ALDER FLY, (Sialis lutarius.)

1. Larva of Sialis lutarius, mag. 2 diams.
2. Ditto, laid open.
3. Nympha of Sialis.
4. Digestive apparatus of larva, magnified
5. One of the branchial filaments, mag. shewing tracheal branchlet.
6. Leg of larva
7. Labium of ditto. 7*. Mandible
8. Digestive apparatus of perfect insect.
9. Ovary of
10. Male generative organ.
11. Male insect
12. Cluster of eggs on bit of Sparganium.
13. Ditto, magnified.
14. Female insect, laid open.

THE NATURAL HISTORY OF THE ORL OR ALDER-FLY OF THE ANGLER.

BY REV. W. HOUGHTON, M.A., F.L.S.

(*With a Coloured Plate.*)

Every fly-fisher, worthy of the name, must often have observed in the months of May and June, a rather large dull-brown fly, with a dark thorax and strongly reticulated triangular wings, which are deflexed at the sides, forming a kind of roof when at rest. This insect is extremely common and widely distributed in this country, and may frequently be seen on the leaves of trees overhanging brooks, or on the stems of reeds and rushes, upon which the female deposits her cluster of eggs. The insect in question is the Alder or Orl-fly, the *Sialis lutarius* * of scientific writers. As I have lately been studying the natural history of this insect, I think it probable some of the readers of The Student would like to be introduced to it. As a rule I find that anglers, however expert they may be in catching the wary trout, care little about the natural history of the fly whose form they try to imitate. It is, for instance, a common belief amongst non-naturalist anglers, that the green and grey drake (May-fly) proceed from the caddis or stick baits. I have often tried in vain to convince them of their mistake, by telling them I had seen the May-fly insects emerge from uncovered nymphæ in hundreds of instances. But let us now proceed at once to the history of *Sialis lutarius*. These insects belong to the family Sialidæ of the Neuropterous order. There are, I believe, only two sub-families belonging to this group, namely the Sialides and the Corydalides, but as the last named are inhabitants of North America, we shall take no notice of them here. Of the sub-family Sialides, Pictet describes two species, *Sialis lutarius*, and *S. fuliginosus* as being found by him in the neighbourhood of Geneva. I do not know whether this last named species occurs amongst the British fauna. The *S. lutarius* has a head of moderate size, with a large square pro-thorax, the labrum is cleft in the middle, the jaws being horny and hook-like; the anterior wings are larger than the posterior ones, and strongly reticulated, the antennæ are long and filiform with many joints. The eyes distinct, but there are no ocelli. So sluggish are the Alder-flies that one may generally pick

* So called from the habits of the larva which lives in the mud (*lutum*) at the bottom of ponds, rivers, etc.

them off, one by one, from the stem on which they have located themselves, with no other instrument than the naked hand. Their flight, too, is heavy and never prolonged. From the structure of the mouth one would suppose that the perfect insect feeds; I have, however, never detected it taking food; in the larval form they are voracious enough. What a difference there is in this matter of taking food amongst the perfect insects of the Neuropterous order! The imago of Ephemera never eats, and has an intestine which is converted into an air-bladder. On the other hand, how voracious are the dragon-flies, Œshna, Agrion, Libellula, &c.! From the rudimental state of the mandibles in the Perlidæ, one would conclude this family, too, does not eat. The female Sialis, which is larger and fuller than the male, deposits her eggs upon the leaves and stems of plants overhanging the water. These clusters of eggs (Fig. 12) are extremely pretty objects; it will be seen from the drawing that they are cylindrical with a narrow point at the top, of a reddish-brown colour, and that they are attached with the most precise regularity. Firmly holding on by her legs to the leaf of a plant, as a *carex* or *sparganium*, the female may often be observed in the act of oviposition, laying her eggs in the regular manner as described; at first they are whitish, but they soon turn to a reddish brown. The female instinctively selects as places whereon to lay her eggs those plants which grow in the water, or whose leaves overhang it; in about ten days time, as far as I remember, the young larvæ are hatched and drop into the water where they pass their earliest stage. And very curious little things these minute larvæ are; Fig. 1 is a magnified representation of an adult specimen; the newly hatched individuals are very similar to the older ones, only that the head is relatively broader in the young specimens. Let us now look at a full-grown larva, whose form, perhaps, may be familiar to many collectors of creatures for the fresh-water aquarium. But first, where shall we find these Sialis larvæ? A strong canvas net pushed amongst the weeds and mud at the bottom of rivers and canals will secure an abundant supply; if the mud is emptied on the bank, the brown, shining, crawling things will soon show themselves. If we put a specimen in a saucer of water, we shall see that the body is elongated, having on each side of the abdomen seven pairs of filaments, and at its termination a long hairy tail. With the help of a lens we see that these abdominal filaments are five-jointed; we notice six legs of moderate length terminated by two claws. The animal has rather a ferocious aspect, and takes care to let us see it has a pair of

strong jaws armed with two teeth. The upper lip is large, widely triangular, diminishing in front to a point, with finely crenelated edges, and no doubt helps the larva to retain its prey. The antennæ have four articulations; the thoracic segments are nearly of equal size, but the first segment is a little larger than the other two. The abdomen has nine segments, of a dark brown colour, with a pale spot in the middle, at the end of the ninth segment there is a long caudal prolongation having on either side of it many long fine hairs. This caudal appendage aids the larva in swimming. The structure of the mouth and the short intestinal tract are evident indications of the predacious habit of the larva of *Sialis lutarius*. The larva can crawl freely; it swims well and not unfrequently shoots itself backwards. The jointed filaments which fringe the abdominal sides are branchial organs of a very beautiful construction; if a segment of the larva be cut off from the body and placed with its attached filament under the microscope, one sees at first sight the function of these organs; proceeding from the large lateral tracheal branch is to be observed a small tracheal branchlet running down the whole length of the filament dividing itself into numerous arborescent tracheæ on either side (see Fig. 5). These filaments then serve not only the purpose of respiration, they also aid as paddles in locomotion. "How ingenious has creation been," says Dufour, "in attaining this double physiological end! Here is this oar so conveniently compressed to strike the water with its flat side as the animal progresses; see how the double row of hairs extends to rule its movements or determine its rest. How sublime is this agreement between the organ and its function, between matter and mind, cause and effect in animals whose minute dimensions escape the eye of the vulgar! Happy, a hundred times happy the man whose intelligence is prepared to seize and comprehend these physiological beauties."

Let us now look at the digestive apparatus of the larva of *Sialis lutarius*. The œsophagus as far as the end of the thorax is nearly the same thickness throughout; there appear to be no salivary glands nor any trace of the pouch which is to be seen in the imago. After entering the abdominal cavity the tract dilates into a more or less marked crop (Fig. 4). At the end of this crop we notice the ventricule, an elongated cylindrical body presenting under favourable conditions an annular structure. At the bottom of the ventricule we observe three pairs of hepatic vessels—the equivalent as is generally supposed of the liver in animals of higher organization. These consist of long brown filaments more or less

twisted together, but all pouring their secretions into the ventricule. After this we find a short cylindrical intestine with a dilated muscular portion of it which may answer to the rectum.

The larva when full grown burrows into the adjoining bank and then forms a cell wherein it is transformed into a pupa, which shows little signs of activity (Fig. 3). The perfect insects appear in great numbers in the months of May and June.

ST. ERMIN'S HILL.

BY SIDNEY CORNER.

A LITTLE southward of the cutting now forming for a portion of the Metropolitan Railway in York Street, Westminster, is a spot full of interest to the antiquarian.

Few persons passing through this locality are led to inquire the origin of "St. Ermin's Hill." The name is a singular corruption or misnomer continued for many a generation; yet, in its sound, may be traced associations of a high antiquity, before even that time when the sweet loneliness of Thorney had attracted the Saint King towards it as a home and a resting place.

The antiquities of Westminster have been the theme for many an able pen, but with the exception of "Norden," the topographer, who wrote in the time of Elizabeth, little mention is made of the origin or rather derivation of that name by which its once main thoroughfare is still known. For Tothill Street, in the old time, was a street of much repute as the principal one for business, and its gabled roofs and casemented windows are yet fresh in the remembrance of many who remember it as such.

From 1488, the period when the Bishop of Chester lived here, down to the period of George II., when the temporary residence of Frederick, Duke of York, changed the name of Petty France to York Street, the locality was looked upon as the court end of the town, pleasant to dwell in as being near the fields. In it also was a very interesting relic of the past, the "Cock" public house, where was the pay table for the workmen building the Abbey. This sometimes ascribed to the building the western towers, would not agree however with the old tradition of the "penny a day," which would point to a more remote period; and curiously enough, upon pulling down this ancient timbered hostel, many gold florins of the

period of Henry III. were discovered secreted among the timbers or behind the partitions.

But we pass on through this street into the Broadway, bearing a little to the left; when, on the right hand, is a turning where the ground is slightly raised, and the name "St. Ermin's Hill." The old chronicler Stow mentions it as "St. Hermit's Hill," when speaking of Vaudun's almshouses; as, however, there is no Saint Hermit or Saint Ermin in the calendar, we can only see the transition from Hermes to Hermit, and going back to a period when the prefix of saint was unknown, we have at once the Roman conventionalism.

Singular and interesting are the associations awakened by this site—Celtic, Saxon, and Roman have passed away; dark and mysterious superstitions have faded before the light of Christianity; shall we compare the past and the present? for here we stand on a spot of high antiquity, and once sacred alike to our Saxon forefathers and the invader; when the Tot or Thoth of Gaul was recognised by Cæsar as identical with the Latin Mercury and the Greek Hermes, which latter appellative was most frequently in use.

Now Cæsar, in his Commentaries, observes, that the youth of Gaul were sent into Britain as to a most ancient and hallowed school, to be instructed in the Druidical rites, and he observes that Mercury was the chief object of popular veneration among the Britons. That there were *plurima simulacra,* many stones or images of this god. Not indeed that the Roman Mercury was actually worshipped by that name before Cæsar's arrival in Britain, but stones being sacred to Mercury among the Greeks and Romans, and Cæsar perceiving that artificial hills surmounted by a stone or *simulacrum* were particularly venerated, he thence concluded that Mercury was the god held in chief esteem.

Let us now, however, see how far we may identify the site of this once sacred mound in Westminster.

Norden, the topographer, who wrote in the reign of Elizabeth, says, "Tootchill Street lying on the west part of this cytie taketh name of a hill near it which is called Toote Hill, in the great feyld near this street." Therefore the hill existed in Norden's time. Also in Rocques' map, 1746, a hill is shown in Tothill fields, just at this bend towards the ancient causeway of the Horseferry Road, and Cæsar says of the Britons, that they made Mercury a guide over the hills and trackways.

In Hone's "Year Book" may be found a remarkably interesting letter from Mr. Edwin Lees, of Worcester, who therein states at some length the origin of Toot hills consecrated to the Celtic

divinity Teutates, and he subjoins a list of some seventy places in England where mounds exist commemorative of Teutates, or which have existed, as may be naturally conjectured from the name.

Mr. Bayne read a paper before the Royal Society of Literature, in 1829, in which he identifies the Celtic Teutates with that benefactor of mankind, who from the invention of various useful arts was worshipped in Egypt and Phœnicia under the name of Thoth, in Greece as Hermes, and by the Latins as Mercury.

To show the connection between the British "Tot" or "Teut" and the Egyptian "Thoth," it may be remarked, that Bruce says the word "Tot" is Ethiopic, and means the Dog Star; now, the Egyptians represented Thoth with the head of a dog, and Mr. Bowles in his "Hermes Brittanicus" remarks, that the Druids cut the sacred "vervain" at the rising of the Dog Star.

Mr. Toland, in his curious "History of the Druids," has also very ably treated this subject, so that further observation in respect of derivation becomes superfluous. It appears, however, that the worship of Belenus was united on these Toot hills, and according to Mr. Bowles, a well in honour of Belenus or the Sun existed at Tottenham, Middlesex, as also at Sulgrave, in Northamptonshire, where, he observes, is the sacred well and the consecrated mound.

But to refer once more to Mr. Toland's interesting book, he says, "On the tops of mountains and other eminences in Ireland, in Wales, in Scotland, in the Scottish Isles, and in the Isle of Man, where things have been least disordered or displaced by the frequency of inhabitants, or want of better ground for cultivation, there are great heaps of stones like the Mercurial heaps of the Greeks; that these *heaps* were called *carns*, that on May eve, Midsummer eve, and the eve of November 1st, prodigious fires were lighted on these *carns*, and that these fires were in honour of Beal or Bealan Latinized by the Roman authors into Belenus, by which name the Gauls and their colonies understood the 'Sun.'"

As regards this Fire-worship, which by the way prevailed over the whole world, the Celtic nations kindled fires on Midsummer eve as before observed, and these fires are still continued by the Roman Catholics of Ireland, making them in all their grounds, and carrying flaming brands about their cornfields. This they do, likewise, all over France, and in some of the Scottish Isles. These Midsummer fires and sacrifices were to obtain a blessing on the fruits of the earth, now becoming ready for gathering, as those of the 1st of May that they might prosperously grow; and those of the last of October were a thanksgiving for finishing their harvest. But in all of them

regard was also had to the several degrees of increase or decrease in the heat of the sun.

That these rites, sacred to Apollo or the sun, were observed in Italy, the following quotation from Dryden's "Virgil" shows :—

> "O! Patron of Soractes high abodes,
> Phœbus, the ruling power among the gods,
> Whom first we serve, whole woods of unctuous pine,
> Burn on thy 'Heap,' and to thy glory shine.
> By Thee protected, with our naked soles,
> Through flames unsing'd we pass, and tread the kindl'd coals."

"Fleet," a monkish writer, speaks of the City of London as worshipping Diana, and the suburbs of "Thorney" as offering incense to Apollo. We are not ignorant, however, that Sir Christopher Wren, when employed to survey the Abbey at Westminster, rejected as fabulous the tradition of a temple dedicated to Apollo having once occupied that site; and though he examined the walls and ornaments about it with the nicest care, yet he could not discover the least fragment of cornice or capital to indicate the handywork of a Roman builder. But as Sir Christopher rejected for the same reasons the tradition of the Temple of Diana standing on the site of St. Paul's, and that such traditions had been credited by learned antiquarians before his time, I do not think that the finding or not of fragments worked in the buildings at either spot should have had much weight. Such fragment would naturally be carefully removed or obliterated by the Christian builders of the middle ages in their rebuilding, and especially as regards the Abbey Church of Westminster. Sebert, in 616, is said to have thrown down this Pagan temple, and to have erected the first Christian church. The next who enlarged and repaired the church of Sebert's foundation was Offa. Now when it was almost ruined by the Danes, Edgar was the next to restore it by two charters in its favour, afterwards confirmed and enlarged by Edward the Confessor. The old one was then pulled down, and a new one erected. Whilst, 200 years after, the whole was again pulled down by Henry III., and finished about sixty years afterwards, in the reign of the first Edward. In such alterations as these, and, as before observed, the obliteration by the Christian builders of all vestiges of the Pagan worship, we may readily account for the disappointment of Sir Christopher, and his consequent rejection as fabulous of such tradition.

It is, however, certain that the Romans paid especial attention to the *genii loci* of the countries they conquered, and would venerate

equally with the Britons these Teut hills and Belen fires as dedicated to their own gods, Mercury and Apollo. It would be most likely research in the lowest foundation that any Pagan relics would reward the inquirer, as was and has been the case at St. Paul's in London, and its immediate neighbourhood.

But whether this temple of Apollo ever existed or not on the site of the present Abbey, it is well known that the worship of Beal and Teutat were united, as before observed. And as the Romans held these sacred rites in equal veneration with the Britons themselves, a dedication to Apollo would most naturally be the result.

I have, however, wandered too far from the site of the sacred mound where the chief point of interest lies, in the connection between the present name with its Greek original.

It is well known that the Latins were frequently in the habit of substituting Greek expressions for their own, and during their 400 years' sojourn, such terms would become common in their use. No wonder, therefore, if this spot sacred to Thoth, Tot, or Teut, became the "Hill of Hermes" at this period, whilst in the progress of time some Christian saint may have been supposed to have had his cell in this most rural suburb, and thus this easily accounted for prefix is mentioned by Stow as before stated.

I have little more to add, in a communication which may possibly have become already too tedious; but as it may be curious and interesting for persons who reside in the vicinity of such places as bear a name originating in this ancient British superstition, and to note any relic of it, I will relate a circumstance which may be suggestive (the sole object of this paper) to those who reside near such.

On the Romney estate, in Westminster, a portion of the land is occupied by Marsham, Romney, and Tufton Streets, and uniting Marsham and Tufton Street is a court known as Bennett's Yard. Here, some twenty years ago, a freeholder had occasion to dig deeply for drain or sewer, and at a depth of about nine feet he found the workmen had come to some *débris* which then had no particular value in his estimation. A small marble head was, however, kept by him as a curiosity, being found at such a depth beneath the surface. The head is of Roman workmanship, and of Parian marble, broken off at the neck. It is a fine head of Hadrian, and about six inches in circumference. From a description of the *débris* at this depth, viz., nine feet, I should be led to think that still more interesting remains might have been discovered. No further research was made, and the place has been covered up

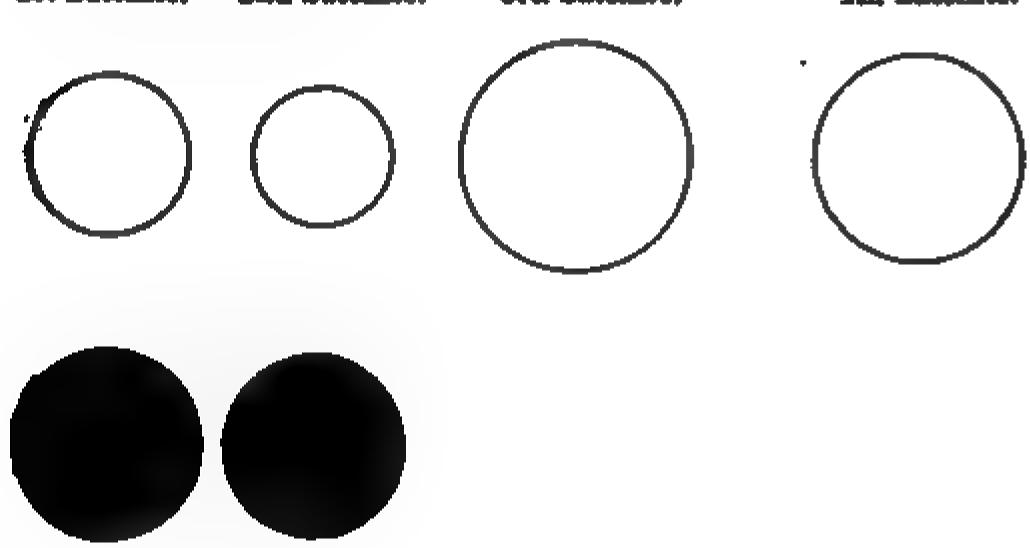
again since that time. I mention this circumstance, because it has been stated by many antiquarians that no remains of Roman workmanship had been heretofore discovered, and it may serve as a good reason for stricter investigation at any time when a similar opportunity should occur.

JUPITER'S SATELLITES.

BY R. A. PROCTOR, B.A., F.R.A.S.

ATTENTION has been attracted of late to the peculiarities presented by Jupiter's satellites. Many observers had an opportunity of scrutinizing three of these bodies in transit across Jupiter's disc on the night of August 21, 1867, and the discoveries made of old by Cassini and Maraldi were recalled to mind, or, in some instances, propounded as new discoveries. There is, in reality, a considerable amount of mystery about the Jovian satellite system; and the observations which were made last year, do not appear to me to clear up, but rather to increase our difficulties. I propose briefly to notice some of the more interesting results, and to correct a few errors into which some observers have fallen in the interpretation of what they have seen.

1st Satellite. 2nd Satellite. 3rd Satellite. 4th Satellite.



Shadow of 1st Satellite. Shadow of 2nd Satellite. Shadow of 3rd Satellite. Shadow of 4th Satellite.

The figure shows the relative size of the four satellites, according to the best modern measurements, and the dimensions and character of their shadows. The shadows have not, indeed, been *seen* as here

shown. No telescope yet constructed having sufficed, it would seem, to exhibit the penumbral band surrounding the true shadow as a distinct feature. Yet it must not be supposed because the shadows are not seen as here shown, that any reasonable doubt can exist as to their true character. The determination of the extent of the penumbra surrounding the true shadow is a matter of very simple calculation. Thus, in the case of the fourth satellite, we have, first, the distance of the satellite from Jupiter's surface equals 1,150,000 miles (in round numbers). Now the Sun, as seen from Jupiter, or from any part of his system, subtends an angle of about 6′; and a moment's consideration will show that the width of the penumbral band is determined by supposing two lines to be drawn from a point on the satellite's limb to the planet (and, therefore, each 1,150,000 miles long), inclined to each other at an angle of 6′, the chord joining the ends of these equal lines gives the required width (technically, the width is the chord of 6′ to radius 1,150,000 miles). From mathematical tables it is readily found that this chord is about 2,000 miles long. This, then, is the width of the penumbra. If the Sun were a point, the shadow would, of course, be exactly as large in appearance as the satellite itself, that is, would be a circle about 2930 miles in diameter. Half the penumbral band lies within, half without such a circle. Hence, the diameter of the true shadow is only 930 miles, and the penumbral band around this being 2000 miles wide, the diameter of the space covered by umbra and penumbra is 4930 miles. It is easy to calculate in like manner the figures of the other four shadows. We may thus draw up the following little table :—

Sat.	Distance from Jupiter's surface.	Diam., in miles.	Width of penumbral band.	Diameter of true shadow.	Diameter of penumbra.
I.	223,180 miles	2352	390 miles	1962 miles	2742 miles
II.	380,956	2099	655	1434	2764
III.	634,193	3436	1100	2336	4436
IV.	1,148,623	2929	2005	924	4934

These are the dimensions presented in the figure.

But now it is quite clear that although the actual extent of the penumbra must be such as is here shown, yet no telescope could possibly reveal the full extent of the penumbra; since its outer limit passes insensibly into the general illumination of Jupiter's surface.

And different telescopes will present the apparent dimensions of the shadow differently. It would, of course, be absolutely impossible to compare the efficiency of one telescope directly with that of another in this respect; because no amount of practice in the use of the micrometer would enable an observer to estimate the apparent width of the shadow with the requisite exactness. But it is not difficult to compare the work of two telescopes in revealing the extent of Jupiter's shadows indirectly. For it is very obvious that a telescope which does not reveal faint shades well, would exhibit the shadow of the fourth satellite as *perceptibly smaller* than that of the third; whereas, a telescope more efficient in this particular respect would show the shadow of the fourth satellite *larger* than that of the third. Or, even if only the fourth satellite and its shadow were transiting the disc, it is obvious that the former telescope would make the shadow seem smaller than the satellite, while the latter would make the shadow larger than the satellite.

Now, the records of observations made on August 21, 1867, seem to exhibit a contrast between the work of reflectors and refractors, in the respect we are considering, which seems well worthy of attentive notice just now that the rival claims of reflectors and refractors are in question. I will compare a few observations of this sort, premising that much more evidence would be required for the satisfactory determination of the question at issue.

First, taking refractors, we have the following observations:—

1. An uncertain account of observations (with $3\frac{3}{10}$-inch object-glass), by Messrs. Perigal and Galton; "The shadow of the third was *intensely black* . . . the shadow of the fourth *large* and dark.

2. Observation by Mr. Dawes; "The fourth satellite was so extremely dark as scarcely to be distinguished from its shadow, *except by the smaller size of the satellite.*"

3. Observation by Mr. Barneby (with a 9-inch object-glass); "The fourth satellite was as black as its shadow, and *of about the same size, or a little smaller.*"

4. Observation by Mr. John Joynson (with a 6-inch lens); "*A sort of border could be seen* round the shadows of the third and fourth satellites; but none round that of the first." This observation is the only one I have met with in which the penumbræ of these satellites' shadows have been spoken of as distinguishable. Mr. Dawes, looking expressly for the phenomenon (in the case of IV's shadow), failed to notice it. So, also, did Mr. Barneby.

5. Observation by Mr. C. Leeson Prince; "The shadow of the fourth satellite was decidedly irregular, and *larger than the satellite itself.*"

I have seen also accounts of other observations with refractors, in which the shadow of the fourth satellite is spoken of as being larger than that of the third; but I cannot at this moment light upon them. I may add to the above a brief glimpse of Jupiter's disc obtained by myself at Mr. Bishop's observatory. The night was very unfavourable for observation, and the fine 7-inch refractor was used with a low power; but during the brief view I had of Jupiter, I noticed that the shadow of the third satellite seemed decidedly darker and smaller than that of the fourth, and this impression was confirmed by a gentleman present who subsequently obtained a somewhat better view of Jupiter. It must be remarked that I had set myself to seek for an answer to this particular question only, and that I knew the exact spots on which to look for the satellites and their shadows, so that though Jupiter appeared to us that night only by momentary glimpses, I was prepared to make rapid use of these.

Next, of reflectors, we have the following instances :—

1. Observation by Mr. Grover (using a 6-inch reflector); "The lighter tint of III., clearly distinguished it from the shadow of IV., *which also was much smaller.*"

2. Observation by Mr. Weston (with a 9-inch Newtonian reflector); "The shadow of the third satellite was distinctly seen to be larger than that of the fourth. This was perceptible to an observer who knew not that this was exactly in accordance with the relative sizes of the satellites."

But it must be remarked that very large reflectors seem to exhibit their superiority by revealing the true dimensions of the shadow of the fourth satellite. For it has been remarked by Mr. Lassel—who had the advantage of observing Jupiter with his great 2-feet reflector—that "The shadow of IV. is very much larger than the satellite itself, even to the amount of double the diameter, and the same shadow is larger than that of III., though the satellite itself is smaller than III."

It may be remarked here, in passing, that a difference corresponding to that here discussed respecting the satellites' shadows, exists in the nature of the shadow of Jupiter, at the parts of the cone entered by the several satellites. Thus the disappearance of IV. takes a much longer time than that of I., not *merely* on account of the slow motion of IV. (as is commonly stated) but on account also of the much wider fringing of penumbra in the cross-section of the cone of shadow where IV. enters it, as compared with the fringe in the cross-section where I. enters.

What opinion are we to form respecting the rotation of Jupiter's

satellites? It seems to have been accepted by many as beyond cavil that the satellites turn always the same face towards their primary. I have myself expressed this opinion, in a paper on Jupiter in the "Popular Science Review," for July, 1867. But it seems to me now far from being clear that the satellites move in the manner described.

As respects the first and second satellites, I am not aware that any observations have been made which appear positively opposed to the results supposed to have been established by Sir W. Herschel. For I do not consider the mere fact that a satellite now looks dark and now bright, when transiting Jupiter, to be at all conclusive evidence against Herschel's views. The extreme brilliancy of Jupiter, renders it somewhat difficult to estimate rightly the variations which undoubtedly take place in the illumination of different portions of his disc. And these variations are, I believe, much more effective in producing apparent variations in the appearance of the satellites in transit, than they are in changing the look of Jupiter himself. To explain and illustrate my meaning, any one who has much attended to the transit of the satellites, cannot have failed to notice, that they always show in a marked manner the diminution of the disc's brilliancy near its edge. Either a satellite is scarcely seen when near the limb, and comes out as a darkish spot near the middle of the disc; or the satellite is distinctly seen as a bright spot when near the limb, becoming less distinct, or disappearing altogether near the middle of the disc. Often a satellite is seen as a bright spot near the limb, then gradually diminishes in distinctness, becomes invisible, and reappears as a dusky spot near the centre of the disc, exhibiting the same changes in reversed order as it passes off the disc. Now the gradations in the disc's brilliancy revealed by these phenomena, are far from being so easily perceptible as one would thus be led to expect. So far is this from being the case, that so good an observer as Mr. Browning, an observer who has repeatedly seen Jupiter with large instruments and high powers (which best reveal the phenomenon we are considering), seems never to have suspected the existence of such gradations in the disc's brilliancy. For, in a letter to the Editor of the "Astronomical Register," he speaks of "the edge of the planet" as the part where "the disc is brightest;" whereas the reverse holds.

But there is evidence of more force as respect the third satellite.

In the first place, it has been noticed that the third satellite,

which usually appears as a bright spot near the limb, and dark near the centre of the disc, sometimes reverses this order. Thus Mr. Prince saw this happen on January 31, 1860. But we have more positive evidence, giving us a means of explaining this peculiarity. On the date of the observation just named, Mr. Dawes took a drawing of this satellite. The lower right-hand portion (more than half) of the disc, is occupied by a large dark spot, divided by a sort of canal of light into two somewhat oval portions. On the night of August 21, 1867, Mr Dawes made another drawing of this satellite, which presents a striking resemblance to the former, only the dark spot now occupies the upper left-hand corner of the satellite's disc. Both drawings being made by means of refracting telescopes, there is no room for an explanation founded on a different *reversal* of the image. There is room, owing to the difference in the position of Jupiter's axis (referred to our horizon) at the time of the two observations, for a small change in the position of the spot, but for nothing that would reconcile the observations together, as representing the same face of the third satellite.

But it is perfectly clear that if this satellite turns the same face invariably towards Jupiter, we must always see *the other* face when the satellite is in transit.

We must then accept one of two conclusions. Either Herschel was mistaken in supposing that this satellite turns always the same face towards Jupiter, or else the satellite's surface is subject to very wonderful transformations; to changes such as no member of the solar system has given any example of, unless, indeed, we suppose the satellite to have an atmosphere, in which case the change would be less startling. But whatever form we give to the second supposition (that the satellite's appearance changes) it is quite clear that we throw doubt on Herschel's results. For he founded those results on the assumed constancy of the satellite's appearance. He says that, *invariably*, at certain parts of its (apparent) orbit the satellite presents the same relative brilliancy, *therefore*, he argues, it always turns the same face towards Jupiter. So that either we must dismiss his conclusion as irreconcilable with the planet's change of appearance in transit, or we must dismiss as inexact the observation on which the conclusion is founded.

But let us more closely examine Herschel's observation. He says that the third satellite appears always brightest at the *two* elongations. Does this warrant his conclusion that the satellite turns *once* only on its axis in performing a revolution around Jupiter? Does it not seem rather to indicate, if it does not abso-

lutely require, the conclusion, that the satellite turns exactly *twice* on its axis, during a revolution around Jupiter? It seems to me that it does, and that in this way we get out of our difficulties, since in different transits opposite faces of the satellite would be turned towards the Earth. There is nothing opposed to this view in the drawings made by Mr. Dawes, though, of course it is impossible to consider the inverted likeness between the two views as otherwise than accidental. Nor, indeed, does it seem possible to imagine any explanation involving the identity of the two spots so nearly resembling each other, save the improbable one that the satellite rotates on an axis almost coincident with the plane of its orbit.

Herschel noticed that IV. was always brightest when nearly in opposition—in other words that the face always turned towards Jupiter (on Herschel's hypothesis) was the brightest. This agrees well with the dark appearance of this satellite as usually seen when in transit. It does not seem clear that this satellite has ever been seen otherwise than dark in transit, or that there is any variation in its aspect requiring an explanation founded on important changes over large regions of the satellite's surface.* Professor Grant has indeed presented this view as following almost undoubtedly from Maraldi's observations. But I do not consider that it is sufficiently supported by evidence. A "bright transit" of this satellite if well established, and especially if it occurred upon the more brilliantly illuminated part of Jupiter's disc, would either overthrow Herschel's view, or confirm Grant's view, or both.

It has been asserted that the shadow of II. is remarkably small (as compared with that of I.), considering the size of the satellite, and is also irregular in aspect. If confirmed, this observation would suggest the suspicion that this satellite may owe part of its apparent size to the presence of an extensive atmosphere—or that the satellite is in part semi-transparent. The observation is due to Mr. Grover—a careful observer, and has been confirmed by Mr. Birt who observed the planet with a 12-inch reflector. It may be, however, that the smallness of II.'s shadow is not more distinctly noticeable than the true dimensions of the shadow and penumbra (see figure) would lead us to expect, when the shadow is observed with a reflecting telescope.

* Since this was written I have seen Mr. Dawes's account of his observation of this satellite on August 21. ("Monthly Notices of the Ast. Soc.") He says that IV. appeared uniformly shaded and round, whereas on other occasions he had distinctly seen irregularities upon it.

Three eminent observers, Sir T. Maclear, Admiral Smyth, and Dr. Pearson, record that on June 26, 1828, the second satellite after entering on Jupiter's disc, was seen 12m. after *outside* the limb, when it was visible for 4m., and then suddenly vanished. Is it possible to suggest an explanation of this phenomenon? To me it seems utterly inexplicable.*

Amongst mistakes which I observed in accounts of the phenomena presented on August 21st, the following seem worthy of notice :—

It was asserted by more than one observer that the shadows near the limb assumed an oval figure, "evidently the effect of foreshortening," says one observer—Mr. Grover. Now, if this observation were not wholly the result of optical delusion, it is quite certain that we should have to consider foreshortening as an unsatisfactory explanation. For even when Jupiter is in quadrature, the observer on Earth sees the planet so nearly in the same direction as an observer on the Sun would, that the shadow could not differ in *form* from the satellite it belongs to. Of course to an observer on the Sun the shadow (if it could be seen *through the satellite*) would appear quite circular if the satellite itself is circular, and so it must appear to the observer on Earth, even when Jupiter is in quadrature, and *à fortiori* when Jupiter is near opposition as he was on August 21st, 1867.

One observer noticing the dimness of III. when passing on to the disc suggested that it might have undergone eclipse by IV., whose shadow lay very near the disc of III. This is a natural mistake, but very obviously a mistake nevertheless. The shadow of III. was at the moment in question far from the shadow of IV. Now a moment's consideration will show that if IV. were eclipsing III., the shadow of IV. would not fall on the disc of Jupiter at all, but upon III. The approach of the eclipse would be indicated, in fact, by the approach of the shadows of III. and IV., and by their finally coalescing into one. In reality, however, none of the satellites were in a position to eclipse any of the others on August 21st, 1867, and the paths of the shadows lying along quite different parts of the disc of Jupiter.

It is worth noticing, that though the planes in which the satel-

* As I was writing the above sentence, the following explanation occurred to me. The above-named observers do not (I think) state that they *saw* II. *on* the disc. Now it is just possible that II. was *lost to sight through eclipse by III.* (or less probably by IV.). If, after undergoing eclipse, II. was close on the disc of Jupiter, the satellite would take about 4m. in disappearing. Either III. or IV. could eclipse II. for 12m., though IV. could not *totally* eclipse II. for that time.

lites move are very slightly inclined to the plane of Jupiter's orbit, yet the inclination is quite sufficient to render an eclipse of one satellite by another a very uncommon occurrence indeed. The apparent occultation of one satellite by another is far more common, and even the actual occultation of a satellite by another, must happen three or four times as often as the eclipse of a satellite by another. The reason is that—assuming as a rough approximation to the truth, that all the satellites move in one plane, then an eclipse of one satellite by another can only take place when that plane passes through or near to the Sun, that is only for two short periods during the course of one revolution of Jupiter; whereas an occultation can occur whenever the plane passes through or near the Earth, which, owing to the Earth's motion in her orbit, happens more frequently, though still confined to two parts of the Jovian year. The case, in fact, somewhat resembles that of Saturn's rings, whose plane passes twice through the Sun in the course of one Saturnian year, but as often as six times (occasionally) through the Earth during the same interval. The fact that Jupiter's satellites do not travel in one plane renders the occurrence either of an eclipse or of an occultation considerably less frequent, but without affecting the *proportion* between the numbers of either kind of phenomena.

A common mistake respecting the inclinations of the satellites' orbits may here be noticed. It has been stated by Sir J. Herschel, and repeated by many writers, that the fact that IV. very often escapes eclipse for months together is due to the greater inclination of its orbit. This is a mistake. The orbit of IV. is *less* inclined than those of the other three to the plane of Jupiter's orbit. Each satellite has a fixed plane belonging to it, but in which it does not move. The plane in which the satellite moves is inclined at a fixed angle to the fixed plane, but gyrates upon this plane somewhat as the plane of the Earth's equator gyrates on the ecliptic, only with a much shorter period. Now the fixed plane of each satellite passes through the line in which the plane of Jupiter's equator cuts the plane of his orbit, lying *between* those planes, and much nearer the former. In fact the fixed plane of I. is inclined at an angle of only 6″ to the plane of Jupiter's equator, that of II. is inclined 1′ 5″, that of III. 5′ 2″, and that of IV. 24′ 4″. Thus the fixed plane of IV. lies nearest to the plane of Jupiter's orbit; that is the *mean inclination* of IV. is less than that of the other satellites. The *actual inclination* of IV. is also almost always less than that of II. or III., and always less than that of I. Why IV. so often escapes eclipse, is because he is so much farther from Jupiter, that

his inclination, small though it be, becomes more effective. If the orbits of the satellites were visible throughout their extent, they would appear as very elongated ellipses, the ellipse of IV. would be more elongated in figure than the others, but being very much larger its smaller axis would greatly exceed the smaller axes of the others, and would often be so great that the ellipse would fall wholly without Jupiter's disc. In other words there would be no possibility of eclipse at such times, whereas the other satellites can never escape eclipse.

CORRESPONDENCE.

A SUGGESTION FOR THE BINOCULARIZATION OF THE TELESCOPE.

BY PETER GRAY, F.R.A.S., F.R.M.S.

I HAVE been in the habit of occasionally using my microscope as a telescope. I arrange it as follows:—I insert the shallowest object-glass (4-in.) in a fitting of the sub-stage, and view the image formed by it with the microscope, using the 1-in., or the 1½-in., object-glass. The 4-in. thus becomes the object-glass, and the microscope the eye-piece of the telescope. With the 1½-in. object-glass I thus got a power of 15 or 16. I cannot say that the performance, on the celestial bodies at least, is very satisfactory. We have, indeed, no right to expect that it should be so, the object-glasses being corrected for a different state of things from that which obtains in this arrangement. On terrestrial objects, however, the defective performance is less apparent, and I find that at a distance of 12 or 15 feet I can easily enough read *diamond* print. From my window I can command at this season no greater distance than the width of the street; but I can thence make out every detail of the flowers outside the windows opposite.

It so happens that I had a monocular body apart from my binocular body, and it was the former that I used to employ in my telescopic experiments. It occurred to me recently to try the binocular body; and on doing so I was gratified to find that I obtained *perfect stereoscopic vision*, with a full field in both eyes. I distinguish stereoscopic from merely binocular vision. The latter, which has its advantages, is all that I, at least, have ever obtained in the use of a double opera-glass; but with the arrangement I have described, as applied to a group of flowers at a distance of 80 or 90 feet, the view obtained is as distinctly and beautifully

stereoscopic as that which I get in applying the microscope to a group of polycistina.

My object in making the present communication is to suggest whether it might not be worth while to apply Mr. Wenham's binocular arrangement to the terrestrial eye-piece of the telescope. Some modifications would be necessary. For example, the prism would require to be enlarged and to be placed immediately behind the anterior lens of the eye-piece. But the details could easily be arranged. I venture to think that the greater distinctness which experience teaches us would be gained by this arrangement, added to the comfort of being able to employ both eyes in using it, would be considered ample compensation for the additional expense. There is no reason to anticipate deterioration in the performance of this instrument from the modification I have suggested.

St. Paul's Road, Camden Town, September 10, 1868.

AN ATTEMPT TO SEE THE ECLIPSE.

To the Editor of THE STUDENT AND INTELLECTUAL OBSERVER.

SIR,—You will doubtless, ere long, be put in possession of full and accurate details of the late Solar Eclipse, by observers who have been more favoured than I was; but in the mean time it has occurred to me that some little interest may attach to all that has been seen of so striking a phenomenon, and so I have determined to send you a few notes of my experiences as one of a party which proceeded within the shadow for the purposes of observation. At Poona we found ourselves within about sixty-seven miles of the northern limit of the total phase, but as at this season the south-west monsoon is still in force, bringing up heavy cloud masses and frequent rain, and as the weather for some weeks before the 18th of August had been peculiarly wet and unfavourable, it appeared to us desirable not merely to get sufficiently within the belt of totality, but to do so as much to the eastward, removed from the heavy banks of cloud which hang over the chain of western Ghats, as the somewhat limited time at our disposal would allow of. One hundred and sixty-three miles of rail, all that is as yet open for traffic of a line which is eventually to connect Bombay with Madras, running in a general direction of about east-south-east, carried our party very comfortably, during the night from the 16th to the 17th of August, to Sholapur, which is just about six miles north of the northern limit. The morning of the 17th was overcast, and so it continued throughout the day, making us feel very uncertain as to the result of our expedition. From Sholapur we had to fall back upon the resources of the country, from the height of civilization in luxurious railway travelling to a rough kind of conveyance

drawn by a pair of very slow and very obstinate bullocks; but we were glad to have even that mode of conveyance, and had the whole day before us to push on along a road leading almost due south, and thus just into the region where we longed to find ourselves. The road, tolerably good at first, certainly ere long became very tolerably bad; and our position being somewhat constrained, four of us in one of these small conveyances, we often preferred getting out and walking, which, besides stretching our weary limbs, enabled us to see more of the country; and we generally found when walking that we distanced our lazy bullocks. The country through which we passed was certainly among the most uninteresting that I have ever seen. It is not absolutely flat, but is just a succession of low and very long undulations. Parts of that through which our railway journey carried us was of excellent dark-coloured soil, carrying at certain seasons heavy crops of grain or of cotton, but now almost everywhere fallow; but as we advanced from Sholapur it became generally very poor, shallow, and wonderfully stony. The whole is of disintegrated trap, forming part of that wonderfully extensive basin of trap extending from the lower spurs of the Ghats near Bombay, up to the immediate neighbourhood of Nagpore in one direction, and far into the Hyderabad territory beyond the part over which we were travelling. The trap has a tendency to break up into curiously-rounded nodules, which seem to consist of concentric laminæ. Many of the fields were thickly strewed with these round nodules of considerable size, having much the appearance of water-rolled boulders; but that where the rock itself crops out the process of their formation may be observed. The superstratum of soil, deeper or more shallow, rests on a bed of considerable thickness, so far as I could judge, of a kind of gravel, locally known as *marram*, consisting of trap-rock more or less comminuted, which is generally of a dull leaden-grey colour, very soft and pulverable—this material had been almost exclusively used in the very poor attempts which had been made to mend the road over which we were travelling—but in some cases where small streams, dry except immediately after heavy rain, had cut more below the surface, beds of gravel of a most peculiarly brilliant red, approaching to a carmine in tone, and wonderfully refreshing in a scene otherwise so monotonous. Villages are small and scattered at long distances, unpicturesque assemblages of mud huts with flat mud roofs; they are generally placed on some small hillock or vantage-ground, always surrounded by a wall, now more or less in decay, but telling of the unsettled, insecure state of society which formerly prevailed. Near these villages are generally a few mangoe-trees, and perhaps a tamarind or two; but the prevailing tree, scattered abundantly over the plain, is the Babul (*Acacia Arabica*), a tree valuable in India for its strong timber, and at this season beautiful with its bright yellow and fragrant blossoms; with *Acacia tomentosa* occasionally, with its far less agreeable white heads of blossoms; *Dichrostachys cinerea*, a thorny shrub, with its flower heads

somewhat elongated, partly yellow and partly pink; *Cassia auriculata*, also rich with yellow blossoms, and, more rarely, one or two others of the same tribe. Besides these, *Calotropis gigantea* is abundant, with others of those plants which abound in barren soils; *Martynia diandra*, with its handsome blossoms and large luxuriant leaves, in patches, especially near the railway; and the brilliant gamboge of *Argemone Mexicana*, which, considered an exotic, seems ready to spring up in every part of India where the soil is disturbed.

Early in the afternoon we reached the small village of Takli, on the northern bank of the Beema, a large river, and at this season running full from bank to bank, and all the low ground in the vicinity showing signs of having been recently flooded. I may mention, that during the day, as we wended our way along, wearily looking out for this river, we were frequently deceived by the mirage on the horizon, giving all the appearance of sheets of water, with trees on their banks, melting away as we proceeded, but far prettier in appearance than we found the actual banks of the Beema to be when we reached them. At Takli we had gained a little over fourteen miles of latitude south from Sholapur, bringing us well within the belt of totality, so that we calculated upon nearly two minutes of total obscuration. Here we found a few small tents pitched, of which accommodation we were glad to avail ourselves; and here our party gradually gathered, consisting of one lady and nine gentlemen; among them some who were sufficiently provided with instrument power, and who were anxiously hoping for the opportunity of using it. We also found that Takli had been selected as a spot for observation by a native gentleman of intelligence, who had with him a small telescope equatorially mounted, and another small telescope. In exploring the banks of the river, during the evening, we found among the deep mud left by recent inundations, several large nodules of kunkur, or nodular limestone, the only calcareous stone which we had noticed during our trip. The evening sky was not very promising, but it got brighter during the night; and as I lay awake on the floor of the tent during the night, I was glad to see the stars peeping in at me through the tent window.

On the morning of the 18th we were all early astir, and many and anxious were the looks at the sky, and the speculations as to results to be expected; it was not promising. At one time we all made up our minds that we could expect to see nothing, and again a gleam of sunshine would fill us with hope; and indeed it was an occasion of peculiar excitement—an opportunity which we had all come from a distance to enjoy, which might never present itself in such perfection in the lives of any one of us again; and would it all be in vain? A low, stony ridge, at a short distance to the eastward of the village, was selected as the most suitable spot on which to establish ourselves. Low as it was, it was the highest ground in the neighbourhood; and there the instruments

were carried and set up. By seven A.M. the sky was much more promising. Though there was still much cloud, it was light, and driving rapidly from west to east, affording often a welcome veil to the eye, and thus, though often obscuring the sun, yet much more frequently helping us in gazing at it.

At 7h. 46m. the first contact was well visible, the black body of the moon advancing slowly and steady, with a very clear, sharp edge, over the bright body of the sun. The temperature of the air, just before the commencement, was 78·5° (F.): by 8h. 30m., exposed to direct sunlight, it rose to 84°. On from this period, as the moon progressed over the sun, we all began to remark a sensible diminution in the amount of light, and a peculiar tone, especially over the horizon all round us, though it was also noteworthy, up even to 8h. 57m. (local time), how much actual light was afforded by a very minute portion of sun uncovered. It was perfectly easy to read the thermometers, watches, or anything else. And now our attention was directed towards the west, where the horizon seemed gradually to be closing in, the advancing shadow having the appearance of dense thunder-clouds rolling rapidly up, the darkness intensifying as it approached; the impression produced on the minds of some of the natives around us being that a terrible down-pour of rain was coming on. I noticed one crow flying to roost, and nearer the village numbers of birds were observed flying to their usual roosts. One of our party pointed out a curious cone of pinkish light, contrasting with the general gloom, and rising from the western horizon for about thirty degrees.

But now, just at the time when it was most important for us to watch the total eclipse, we were greatly disappointed by finding that the rolling clouds were indeed so thick as effectually to shut out all view of the phenomenon we wished to observe; a thick mist came over us—then the peculiar and most impressive darkness, which seemed to come over us in two distinct waves of intensity, a thick mist, and a little precipitation. Oh! how we longed, during those two minutes of darkness, that the cloud would separate, if but for a few seconds; but no, we had entirely missed the total phase. We made several attempts to judge of the darkness, and to compare our experience of it—but it was difficult to find a standard of comparison—it was most, perhaps, like the early dawn on a very cloudy morning. I could not read instruments, or the second hand of my watch; others, with better eyesight, were able to do so. The index of the minimum thermometer, I afterwards found, had in the mean time gone down to 76°. And I cannot but think that, in an atmosphere so nearly saturated with moisture as this is at this season of the year, the mist and slight precipitation was a necessary concomitant of the sudden fall of temperature. I heard of very much the same thing having been experienced at many stations, widely separated, though luckily in some instances the mist did separate for a while during totality, so as to

allow of observations being made, from which we were shut out. In stations with a drier atmosphere, I hope we shall find that more satisfactory results have been obtained. With regard to judging of the amount of darkness, I think that of necessity the eye is hardly prepared for it, as at the last it comes on so suddenly. The pupil is contracted for the ordinary amount of diffused light, and has not time to dilate sufficiently. The darkness passed, telling us that our opportunity was gone and totality over; and with the darkness went all the mist, rolling away from us to the eastward, leaving a sky nicely mottled with a few light cirro-cumuli, and at 9h. 4m. we once more saw the sun well, with a brilliant crescent of light on its upper limb, and could watch the receding of the eclipse, as we had watched its advance; but with far less of interest, for whilst hope and excitement had filled us all before, now there was a feeling of disappointment; the light seemed to return to us with far greater rapidity than it had departed. During the dark period the light of a lamp, or of some small fire, became visible in a village about a mile distant from our station, which was quite unnoticed before.

An example of the stolidity of the native character, at all events in its uneducated masses, was presented to us in the case of a villager, who was ploughing just before us, and who, throughout the darkness, continued his operations as unconcerned as were his yoke of oxen. Some other natives, however, of a different class, to whom we showed the way of watching the progress through smoked glass (our object being to keep them quiet) seemed much to appreciate the sight.

Our return to Poona in the same way in which we had come is not worth resting upon. Though certainly disappointed in our expectations, we were all glad that we had seen as much as we did.

JOHN E. HALLIDAY, Colonel.

LITERARY NOTICES.

A Treatise on Lathes and Turning; Simple, Mechanical, and Ornamental. By W. Henry Northcott. With two hundred and thirty-nine illustrations. (Longmans.)—This work is divided into four parts—the first generally descriptive of lathes and turning; the second entering pretty fully into hand-lathes and their uses; the third treats of self-acting and screw-cutting lathes and their uses; the fourth upon ornamental lathes and their uses. Mr. Northcott's explanations are well calculated to assist amateurs, and his very numerous illustrations of lathes, tools, and ornamental designs add greatly to the value of his book. Ornamental turning is a very pleasing art, and we wonder it is not more widely practised. The mode in which highly-complicated geometrical designs are produced is lucidly explained by Mr. Northcott, and illustrated by a beautiful series of engravings.

The Illustrated National Pronouncing Dictionary of the English Language, on the Basis of Webster, Worcester, Walker, Johnson, etc., with an Appendix, containing Abbreviations, Foreign Words and Phrases, Scripture Proper Names, Forms of Address, etc. Two hundred and fifty engravings. (W. Collins, Sons, and Co.)

The Illustrated Pronouncing Pocket Dictionary of the English Language, on the Basis of Webster, Worcester, Walker, Johnson, etc., with an Appendix containing Abbreviations, Foreign Words and Phrases, and Forms of Address. (W. Collins, Sons, and Co.)—These dictionaries, which are very nearly alike in contents, deserve a hearty recognition as remarkably cheap aids to popular education. The first named is in larger type, and contains the Scripture names, omitted in the latter, otherwise they seem identical except in size. The phonetic system is adopted in the explanation of how words should be pronounced, and we cannot always accept its indications, as it is fatal to nicety of pronunciation, and frequently gives support to downright vulgarisms. In other respects the dictionaries are well compiled, and the illustrations decidedly useful, except in such cases as a portrait of an extinguisher and certain other objects equally well known. Although so low in price, these dictionaries are neat in aspect and in serviceable binding. They deserve a large sale.

Summers and Winters in the Orkneys. By Daniel Gorrie. (Hodder and Stoughton.)—Mr. Gorrie has given us a very interesting account of the Orkneys, partly descriptive, and partly historical, with many illustrations of the present mode of life in those remote and romantic islands. It is not now difficult for the tourist to get so far north, and though modern improvements have, happily for their inhabitants, been rapidly and successfully introduced, there is still much in the Orkneys which

distinguishes them broadly from the scenes of ordinary English or Scottish life.

Until recently these islands suffered much from feudal institutions, and thievish exactions of alleged dues; and kelp making, while it lasted, diverted attention from agriculture. Now we read of "stretches of grain and pasture lands," improvements of tenure, and general increase in the comfort of the people. Mr. Gorrie tells us, however, that the humidity of the climate, the shortness of the summer, and the frequent lateness of the harvest, render it precarious for the farmer to place his sole dependence upon the crops. Agriculturists, accordingly, are becoming every year more alive to turning their chief attention to grazing—a purpose for which the climate and the grass lands are alike admirably adapted. The grazing capabilities of the islands are now so much appreciated, that well nigh 10,000 head of cattle—mostly shorthorns—are annually exported; and many farmers rely upon the sale of live stock as the only means of paying their rent. The principal residents have elegant and convenient houses, but many of the peasantry still live in a style more archaic than desirable. "The doorway" of these relics of other days "is generally so low-browed that any man of ordinary stature must make obeisance to the household gods as he enters and retires. Cows and calves, which have a better right to be called domestic animals in Orkney than elsewhere, are occasionally quartered in one end of the cabin, or share the 'fore-house' with the family when they require careful nurture. Overhead in the rafters, the red cock and the grey, celebrated in Border minstrelsy, roost composedly at dusk beside their wives and concubines, and stir the sleepers at dawn with their loud *reveillée*. A peat fire smoulders in the middle of the floor, or close to the blackened wall, and the smoke, after rising and lingering in wreaths about the rafters, escapes by the same hole that admits the light." The furniture of these cabins consists chiefly of an antique high-backed chair, two or three "creepies," a small table, and "tick-at-the-wa'" clock, and a big box bed. This last indispensable article is fitted up with lid-like doors, which the cottar or his wife almost invariably close when they retire for the night. An enterprising traveller might taste a delicacy adapted to such an abode, in the shape of a piece of dried fish, smoked with cow dung to give it a choice flavour. The Orcadians must exhibit a curious mixture of the progressive with the antiquarian; and it is highly creditable to them that reading and writing are almost universal accomplishments.

From the peculiar position of the islands, the Orkneys have a moderate climate, but in winter rendered sufficiently unattractive by the prolonged absence of sun. They do not have much frost, but an "exceptionally fine" December, in 1865, was marked by twenty-five days on which rain fell, and the month's "sunshine was calculated to amount to only forty-nine hours." May-time is of a more cheerful character, and the autumn is described as an agreeable and picturesque season.

June and July are characterized by fine sunsets, and, from the northern position, twilight lingers until dawn.

For those who delight in wild coast scenery, swarming with sea-birds, and haunted by old Norse legends, the Orkneys offer a great charm, and Mr. Gorrie's book will no doubt add materially to the number of their visitors. It is throughout agreeably written, and full of varied matter, from which it would be easy to cull numerous extracts of considerable literary merit.

Reliquiæ Aquitanicæ; Being Contributions to the Archæology and Palæontology of Perigord, and the adjoining Provinces of Southern France. By Edouard Lartet and Henry Christy. Edited by Thomas Rupert Jones, Professor of Geology at the Royal Military College, Sandhurst. Part VI.—The sixth part of this splendid work enters upon a very interesting topic, the human bones found in the cave of Cro-Magnon, in Dordogne, and described by Dr. Pruner Bey. Four fragmentary adult skeletons and one of an infant were discovered in what appears to have been an undisturbed family burial-place. These human bones were of the same aspect and specific gravity, from want of gelatine, as the bones of reindeer and other animals with which they were associated. The plates of Part VI. are devoted to these remains; but, as Dr. Pruner Bey's paper is only partially given—the remainder to come with the next issue—we have little to remark upon, and defer our comments.

Mr. Leighton Jordan on Vis Inertiæ.—Mr. Jordan writes to say that he does not deny that "the gravitation of the sun and moon cause oceanic tides." He also observes that our printer has substituted "it" for "or" in the passage quoted. Our readers can make the alteration, and see if it is any more intelligible for the change.

The Floral World and Garden Guide. Edited by Shirley Hibberd, Esq., F.R.H.S. (Groombridge and Sons.)—The September number of this popular periodical begins with an article on "The Decoration of an Entrance Court," illustrated with a coloured plate of Mr. Hibberd's forecourt at Stoke Newington. In this paper the editor explains the advantage of the "plunging" system, which is undoubtedly effective, if it is not economical. Following this comes a good paper on the "Plagues of the Garden," containing excellent practical advice that will be particularly welcome in the neighbourhood of London and other large towns, where it is easier to grow the garden plagues than the flowers. The management of a small greenhouse, so as to keep it gay, instructions for growing hyacinths, and several other articles of a practical character, complete the number.

The Sabbath of the Jews, in Relation to the Sunday Question. By Dr. Benisch; being a reprint of a series of articles from the "Jewish Chronicle" of February, 1866. ("Jewish Chronicle" Office.)—We uniformly decline to enter upon theological controversy, not from underrating its importance, but from a conviction that a scientific magazine addressed

to the intelligent of all religions, is not the place for it. We can, therefore, only say that Dr. Benisch has supplied a learned essay, to show what the obligations of the Jewish Sabbath, according to the opinions of the most learned rabbis, really were. He distinguishes them widely from the Sabbatarianism of the Scotch.

The Parsee Marriage and the Divorce Act, and the Parsee Matrimonial Courts. By a Parsee. (Bombay, "Times of India" Office.)—This pamphlet gives a very curious insight into the modifications which Parsee life has undergone in India under British rule, and of the further changes likely to occur. According to the writer, the Parsees have made great progress since our government has relieved them from the tyranny they experienced under native rulers, and they seem to evince great aptitude for advancing in the path of civilization. The Parsee is a monogamist; but he copied the betrothal and early marriage system of the Mohammedans and Hindoos. The result is, that when he gets older, and his mind is more cultivated, he is frequently very dissatisfied with the wife chosen for him by his family, and anxious to sever a contract which produces unhappiness. The Parsee Marriage and Divorce Act stands in the way of his getting rid of his wife on the ground of incompatibility of taste and temper, and the writer thinks the legislature should not interfere with "the social and domestic relations between the sexes." It seems to us that whatever changes in divorce laws may be desirable, the great reform needed by the Parsees is the abolition of the barbarous custom of early marriages, dictated by the parents of the parties chiefly concerned. In no relation of life is freedom of choice more important, and the educated Parsees must be convinced of the folly of the existing process.

PROGRESS OF INVENTION.

Tanning.—Mr. H. Miller Ragland has invented a process for preparing hides to receive more readily the action of tannic acid. After the hair and particles of flesh have been removed and the hides have been properly cleaned by the action of lime, the first step in this new process is to place the hides in water sufficient to cover them. The hides are to be placed in separately with the fleshy side upwards, and are to be sprinkled with bran in the following proportions:—

Light hides, for uppers, etc., each skin	6 ounces
Calf skins	3
Sheep skins	4½
Heavy hides, for sole leather	14

In this vat the skins must remain until fermentation has taken place, which

will be, in warm weather, in about two days, but in cold weather somewhat longer. After this the skins must be removed and scraped from any adhering particles of lime or other substances. When this has been done the skins are subjected to the action of mustard seed, which forms the distinguishing characteristic in this process. It is carried out in the following manner:—A vat of proportionate size is filled with a sufficiency of water to cover the skins, and to this water there must be added for every hundred pounds weight of the skins, when dry, five pounds of ground Italian mustard seed, and five pounds of barley meal. When these ingredients have been thoroughly mixed with the water, the skins must be dipped therein, so that they may be perfectly saturated with it, and they must be left in this dip for the following length of time:—

Calf, sheep, or goat skins...........	24 hours
Light hides and kips	36
Heavy hides, for sole leather	48

When this time has expired the skins must be taken out and hung up to dry, but only partially, as when subjected to the next process they should still be in a damp condition. The dip which has just been described has a very powerful action on the skins; the combined action of the mustard seed, barley meal, and heat thereby generated, is to open the pores of the skins, and thus to render the remaining processes in tanning them by means of bark much more speedy than under any other methods hitherto known.

Extracting Colouring Matter from Madder.—M. Alexandre Claver of Basle, has discovered a method of extracting the colouring matter from madder, which seems to be useful in that it increases the yield of colour. It consists in extracting the colouring matter or properties of madder by petroleum, or other hydro-carbon in the presence of mineral acids. The petroleum or other hydro-carbon is heated to 100°, and the alizarine or flowers of madder brought to a pasty, sticky state with about five times their weight of hydrochloric or sulphuric acid which is added to them. The mixture is kept at the same temperature for an hour or two, it is then filtered, and on cooling, the colouring matter will precipitate from the petroleum which held it in solution. The chief feature in this invention is the use of acids, without which the madder flowers would yield to the solvents only a very small part of the colouring matter. The advantage of the extraction of these products is to be able to apply the madder, that is to say, the colouring matter or properties of the madder, *directly* in printing.

Feeding-bottles.—A very simple improvement in these very useful articles has been made by Mr. T. G. F. Dolby, in order to prevent the return of the breath from the child's mouth into the bottle, and for the admission of fresh air. A conical or other shaped valve of india-rubber or other suitable material is placed in the cap, neck, or top of the bottle,

and a similar valve is also applied at the top or bottom of the tube through which the food passes to the child's mouth.

HOLDING AND RELEASING BLIND-CORDS.—To the frame work surrounding the venetian or other blind, a small frame is to be attached, having two stationary rods or wires, one for carrying three pulleys or rollers, and another for carrying two levers or catches. The double cord used for raising or lowering the blind, passes over two pulleys and over the two levers, and over the third pulley is passed a single cord and connected to a cranked wire jointed to the levers. When the single cord is loose the double cord can be pulled in either direction, and raise or lower the blind, and when the single cord is pulled the crank wire turns the levers, so that their ends press the double cord against the top of the small frame, thereby effectually holding the cord and preventing any change of the blind. When the blind has to be raised or lowered, the single cord is loose and the double cord pulled, so as to turn back the levers for removing the bite and giving freedom to the said double cord. When required the positions of the levers can be reversed, so that they turn downwards to press the double cord against a bottom plate of the small frame.

COLOURING MATTER.—This invention consists in the production of a red colouring matter, by the oxidation of a product isomeric with naphthalamine, and which is obtained by distilling naphthaline and taking the products of higher distillation to mix with the naphthalamine. The naphthaline is treated with nitric acid of 1·33 degrees density; the nitro-naphthaline obtained is then washed and reduced by either iron and acetic acid, or by hydrochloric acid and zinc; this reduction is energetic. It is distilled after reduction. The naphthaline passes over first, then the retort cools a little, and afterwards it is heated to a higher temperature, when a second body will pass over. This product of higher distillation is treated at about 250° Fah. with about 50 per cent of nitrate of mercury, very dry, and a quantity of naphthalamine equal to that of the second body is added. They are left in contact for about a quarter of an hour, and are then treated with boiling water containing an acid, preferably a vegetable acid. The colouring matter is dissolved and the mixture filtered to separate the raw materials. M. Alexandre Claver, of Basle, is the discoverer of this process.

PURIFYING IRON.—Mr. Charles Denton Abel has patented a communication from John Francis Bennett, of Pitsburg, United States, for the purifying of iron, from sulphur and phosphorus especially. After the molten iron has been treated by Bessemer's process for elimination of the carbon, it is further subjected to the action of carbonic acid, which it is said becomes decomposed, the carbon remaining with the iron while the oxygen unites with the sulphur to form sulphureous acid gas which escapes. In like manner the phosphorus unites with the oxygen of another portion of the carbonic acid forming phosphoric acid, and its

carbon remains with the iron, should it be desired to get rid of this carbon air may be passed in as in Bessemer's process, and this carbon introduced by the carbonic acid can be burnt out. There will be also a decomposition of the carbonic acid by the iron with deposition of carbon. While the blast of carbonic acid is passing through the molten iron the temperature of the metal will fall somewhat, losing about one-fourth of the additional heat gained by the passage of the atmospheric blast. This, however, is rather an advantage than otherwise, as it is found that by the atmospheric pneumatic process, the iron is rendered almost too fluid by extreme heat. If preferred the carbonic acid may be heated before entering the converter or vessel where the molten iron is acted upon. Carbonic acid gas may also be used with advantage in removing sulphur, and other impurities from sulphides of copper, zinc, nickle, and other metals by passing it as a blast-current through the metals when in a molten state. A modification of this process may be employed; it consists in allowing a small portion of carbonic acid to enter the blast cylinder together with the air, and thus subjecting the molten crude iron to a combined blast of atmospheric air and carbonic acid gas; by this means the impurities are removed during the process of decarbonization.

CAMERA.—Messrs. E. Johann Krüss, and William Andres Krüss, of Hamburgh, have invented an improved camera for reflecting the magnified images of opaque objects upon a wall or screen. The oxyhydrogen light is at present used for this purpose, but the present invention is to obviate the expense of this method of illumination. The apparatus consists of a case, somewhat like that of an ordinary magic lantern. A candle lamp is placed inside this case, so that the flame is between a curved reflector and two or more convenient concentrating lenses. The position and curve of the reflector are such, that the light of the lamp or candle is reflected towards the concentrating lenses, which are placed in a direct line between the flame and the object to be reflected on the wall; the reflected rays as well as the direct rays from the flame thus pass through the concentrating lenses, which concentrate them on the object to be reflected. The powerful light thus thrown on the object admits of the image being reflected through the tubular mouth of the lantern, and an object glass or lense placed in the mouth magnifies the image to the required size.

FURNACES FOR SMELTING GLASS.—An improvement in the method of creating draughts in glass furnaces, has been patented by Mr. James Davison, of Bishop Wearmouth. At present long caves are placed under glass furnaces, and large cones of brick-work above them in order to get the sufficient amount of heat requisite for the perfect fusion of the materials used in glass making. Mr. Davison's invention does away with these expensive and inconvenient draught creators. He employs steam, which is generated in any suitable boiler, and which is injected into

small flues, chimneys or funnels, by steam-pipes or jets; these he places in any convenient part of the furnace, and one or any number may be applied according to the size of the furnace, and the number of glass pots it may contain. In each flue or chimney the steam pipes or jets may be either fixed or portable; they are provided with stop-cocks so as to regulate the supply of steam, and in this manner a draught is created and the heat of the furnace increased and regulated at pleasure. The principal feature of this invention is, the application of steam injected into furnaces for the manufacture of glass, and the materials employed in that manufacture for the purpose of obtaining the necessary draught; but the flues may also be so arranged as to consume the smoke from the fuel.

ALCOHOL-METER.—Alcohol dissolves chloroform, so that when a mixture of alcohol and water is shaken up with chloroform, the alcohol and chloroform unite, leaving the water separate. On this fact Basile Rakowitsch, of the Imperial Russian Navy, has founded his invention. The instrument he uses is a graduated glass tube into which a measured quantity of chloroform is poured, and to this is added a given quantity of the liquid to be tested; these are well mixed together and then left to subside, the chloroform takes up the alcohol and leaves the water, which being lighter than the chloroform will float on the top; and the quantity of water that has been mixed with the spirit will be at once seen.

DOOR-KNOBS, ETC.—This invention is for the improved manufacture of door, shutter, and bell knobs on furniture, by which the ornamentation of such articles according to any desired pattern is effected with ease. A mould of metal is prepared of the desired shape so as to form the exterior of the knob, and this is to be filled with either white or coloured glass in the molten state. A pattern may be impressed on the soft glass by means of suitable stamps or dies. The glass when cold is removed from the mould, the rough edges are trimmed, and any further ornamentations in colour may be effected by painting in enamel colours, and burning in. The glass so formed and ornamented can be fixed in the usual metal mountings. A brilliant effect may be produced by placing metallic foil, or other suitable burnished or polished metal between the glass and the metal mounting. Mr. John Cross Sanders is the patentee of this invention.

NOTES AND MEMORANDA.

EXCITING LIQUID FOR GALVANIC BATTERIES.—In "Comptes Rendus" M. Delaurier recommends for this purpose 20 parts by weight of proto-sulphate of iron, dissolved, as much as possible, out of contact with the air, in 36 parts of water; add, stirring, 7 parts mono-hydrated sulphuric acid, and then one part of monohydrated nitric acid. This composition is said to be very powerful, and not to disengage any unpleasant gases. M. Delaurier observes that "he brings into action

enough hydrogen to form water and ammonia, and that binoxyde of nitrogen is prevented from escaping by the excess of proto-sulphate of iron which absorbs it, and through the influence of the nascent hydrogen, decomposes it, producing sulphate of ammonia and water, while proto-sulphate of iron remains, having acted as a carrying agent."

ALCOHOL FROM LICHENS.—The "Archives des Sciences" for August contains a translation of a Swedish paper by M. Sten Stenberg, showing the large quantity of amylaceous matter contained in certain lichens, amongst them the reindeer moss (*Cladophora rangiferina*) existing in immense quantities in certain countries of the north. He converts the amylaceous matter into grape sugar by heat and acids, ferments it, and obtains alcohol, which he states to have an aromatic odour like that of almonds.

A GREAT METEOR AT WARSAW.—In "Comptes Rendus," M. Daubrée describes specimens of meteorites sent to the French Academy by the High School of Warsaw. It appears that on January 30, 1868, at seven p.m., in the environs of Pultusk, not far from Warsaw, a globe of fire, seen from that city, passed through the sky with a velocity of 29·6 geographical miles in four seconds and a half, shining brighter than the moon, and passing from bluish green to dark red. Two great explosions occurred, followed by a prolonged rattle, and the hissing sound of fragments passing through the air. The fragments of the bolide were distributed over a surface of sixteen square kilometres in an elliptical area, one of the largest pieces, weighing four kilogrammes, fell in the village of Rzewnie. About three thousand fragments were picked up in different places, the biggest weighing seven kilogrammes, three or four others four kilogrammes, and the majority of much less size. Although the bolide itself moved rapidly, the fragments of the explosion marked the ground with a low velocity, and did not penetrate its icy surface. Their composition was nickel iron, sulphate of iron, chromium iron, a silicate like powder, and another silicate acted upon by hydrochloric acid.

DEVELOPMENT OF THE EGG.—From observations on snails, frogs, newts, etc., M. Perez affirms that an egg begins by the formation of a nucleus at the bottom of the ovary. The second step is the transformation of the nucleus into a cell by scission of its peripheral layer, which individualizes itself into a membrane (the vitelline). Third step, first scission of the nucleus, producing the germinal vesicle and spot. Fourth, deposit of vitelline granulations in the primitive liquid of the ovule. He adds that the genesis and development of the male cells (spermatozoids) follow the same course, but with differences arising from the relative quantity of the vitelline granules.

NEW MEDICINES FROM COCHIN CHINA.—MM. Condamine and Blanchard have sent to the French Academy specimens of the bark of a tree called *haofach*, which the Annamites regard as a sovereign remedy against diarrhœa, dysentery, and colic. Another bark called *couden* had similar properties ascribed to it. Haofach is considered best for certain intermittent fevers, and couden preferred for diarrhœa and colic.

ACTION OF DUCKWEED.—M. Dehérain has a short paper in "Comptes Rendus" on the decay and decomposition of plants in marshy water when duckweed grows on the surface, and intercepts the solar action. He shows that the plants no longer give out oxygen, and that fish die for want of that element. This he considers the true cause of their decease, and not the presence of sulphuretted hydrogen, arising from the decomposing submerged plants.

NEW VINE DISEASE.—The attention of the French Academy has been called to a disease of the vine, produced by a kind of aphis, designated Rhizaphis, which attacks the roots and impoverishes the sap. This aphis is represented as having no excretory orifice, and as belonging to a new genus.

ZOETROPE DESIGNS.—The London Stereoscopic Company request us to state that several of the zoetrope designs which we have figured are their copyright.

THE COLOURS OF SATURN.

BY JOHN BROWNING, F.R.A.S.

(*With a Coloured Plate.*)

In Mr. Proctor's admirable monograph, "Saturn and its system," the colours of the planet are thus referred to:—"No object in the heavens presents so beautiful an appearance as Saturn, viewed with an instrument of adequate power. The golden disc, faintly striped with silver-tinted belts; the circling rings, with their various shades of brilliancy and colour; and the perfect symmetry of the system as it sweeps across the dark background of the field of view, combine to form a picture as charming as it is sublime and impressive."

Yet this glowing description will give a very inadequate idea of the wondrous display of colour exhibited by the planet, when it is viewed with great optical power, and under a highly favourable condition of our atmosphere.

With a telescope of only two inches aperture, Saturn may be seen of a golden yellow, provided a tolerably high power be used, but it is only when an instrument of very large aperture is employed that the great variety of colours of the various parts becomes apparent.

In this case, also, to obtain the contrast of the colours in their greatest intensity, a proportionately high power, say sixty to every inch of aperture, must be used; owing to unsteady air, such a power cannot always be applied with advantage even to a three-inch telescope, and the nights that so high a power can be satisfactorily employed, with an aperture exceeding ten inches, are few indeed.

The colours of Mars are best seen when the air is somewhat misty, and this is generally the case with Saturn. Occasionally, however, the colours may be well seen on a clear night, and misty nights will occur on which little colour is perceptible.

The cause of this has not yet been fully elucidated, though, perhaps, the arrest of the blue rays of light by a misty atmosphere may be considered sufficient explanation.

The following notes, of recent colour observations, were written at the telescope:—

"May 9th, 1868. Midnight. Observed Saturn with 12¼ inch. Air very steady, at intervals. Power 100, no perceptible colour. Power 200 to 450; ring, lemon yellow; globe, light cinnamon, with

darker belts, scarcely same colour; Ball's division, purple-chocolate; crape ring, same colour; pole of the planet, *bright azure blue.*"

"May 14th. Definition very fine, much better than on the 9th. Took a set of measurements of the planet. Colours not nearly so vivid as on the 9th. Air misty, the N. pole of the globe *neutral grey* and *darker* than any other part of the globe, excepting the broad reddish-brown belt immediately N. of the equatorial bright belt. No part of the globe pure white.

The coloured drawing, now so faithfully reproduced, represents the planet as seen on the foregoing nights, with a 12-inch silvered-glass mirror, using a power of 500.

With such a power, the whole ring system produces the impression that it consists of fine lines. Slight inequalities may, sometimes, be detected in the belts of the globe; more generally they appear quite regular, like the rim of a wheel in rapid motion. In this particular, the globe of Saturn presents a marked contrast to that of Jupiter, to which, in many other respects, it bears a strong resemblance. Like Jupiter the globe is greatly flattened at the poles; is surrounded by a cloudy envelope; has a permanent bright belt, about one-seventh of its diameter, encircling it at the equator: add to these points of comparison, that the dark belts of each planet near the equator are of a chocolate-red tint, while the poles are blue. Here the resemblance ceases. The red belts of Jupiter are dark and rugged, those of Saturn are faint and smooth. Though this uniformity detracts somewhat from the interest with which the belts are examined, it adds greatly to the unique beauty of the planet.

In the drawing from which the engraving is copied, the following colours were used to represent the parts indicated—

The rings, yellow-ochre, shaded with the same, and sepia. The globe, yellow-ochre and brown madder, orange and purple, shaded with sepia. The crape ring, purple-madder and sepia. The great division in the rings, sepia. The pole and the narrow belts, situated near to it on the globe, pale cobalt-blue. These tints are the nearest I could find to represent those seen on the planet, but there is a muddiness about all terrestial colours when compared with the colours of the objects seen in the skies. These colours could not be represented in their brilliancy and purity, unless we could dip our pencil in a rainbow, and transfer the prismatic tints to our paper.

Hearing that I was engaged on this subject, Mr. Huggins very kindly sent me the following interesting notes, concerning his own

observations. Coming from such an authority, I am sure I need not apologise for reproducing these notes here. Mr. Huggins says:—"Though I can see the colours of Saturn fairly well with powers of 500 or 600, yet I find that a power of at least 900 is necessary to bring out the contrast of the colours in the fullest manner. Probably reflection, by a solar eye-piece, would answer with a lower power. Inexperienced observers must be warned that, in consequence of the small altitudes of Saturn, there are prismatic colours seen on it, produced by our atmosphere. From this cause red is seen along the upper-edge of the planet, in an inverting telescope, and a strong blue at the lower or north edge of the ring, and at the pole. Some years ago, I considered the crape ring to be of the colour of watchspring, lately I have considered it rather more of a greyish blue." Regarding this, I may remark that Mr. With informs me that he sees the crape ring of a purplish blue, and Mr. De la Rue makes it a light purplish-chocolate. The colour will, however, vary greatly with the state of our atmosphere. When we have much mist in the air, the colour will incline towards red, when the air is clear, the colour will become a purer blue.

Unlike Mars, of which the oceans, seas, inlets, bays, continents, and islands, have been named, and charts and globes constructed, nothing is known of the physical conformation of the surface of Saturn. The spectroscope, that powerful instrument of modern research, affords us no information. In the absence of actual knowledge, conjecture may be permissible. The researches of mathematicians lead to the conclusion that the rings of the planet consist of a countless multitude of minute satellites. These small bodies, probably, resemble the planet Mars, in colour, and the different tints on the various portions of the rings may be due to an unequal distribution of the satellites in different zones. Their colours may be further modified by the presence of an atmosphere, and that the rings have an atmosphere is, I think, pretty certain, from the appearance they present, when their edges are turned towards us, nebulous appendages, like clouds, having, when they were in this position, been seen upon them.

The surface of the globe of Saturn may have a soil of a colour resembling our Bagshot Sand, or New Red Sandstone, this would certainly be greatly modified by cloud-belts, which exist principally at the equator, but extend to the poles. The poles may consist of masses of ice. It is very difficult to account for their strong blue colour upon this hypothesis. Yet the same difficulty would be experienced in the case of Mars, whose poles appear light blue or

light green to many observers, and the existence of ice on these poles may be almost considered as proved.

The uniformity of the red belts would seem to indicate that the whole of the surface over which they extend must possess the same character. If, as I have supposed, the colour is due to the soil, the seas must be confined to the poles of the planet.

ANCIENT MINTS AND MODES OF COINING.

BY JOSEPH NEWTON.

The usual gradations through which almost all branches of mechanical art have passed in their progress towards perfection are distinctly traceable in the manufacture of metallic money. In the earliest periods of history the whole of the operations connected with the production of the coinage, in all countries, were performed by skilled manual labour, and this system undoubtedly continued in existence in England for many years. Afterwards the power of horses was enlisted into the service of the monetarii, or minters of the kingdom. Then the force of water, made to pass in its course seaward, over, or under wheels, was employed in propelling the primitive machines in use in the various provincial mints; and finally, that mechanical triumph of modern times, the steam engine, became the motor to which the community is indebted for the circulating medium.

To inquire into and explain "the gradual steps and slow" by which the latest improvements in the art of coining money have been attained, cannot be a work devoid of interest, either to the antiquarian or the archæologist; and with as much brevity as is consistent with lucidity the task shall be attempted. From the earliest records extant, having reference to mint matters, whether existing in the library of the British Museum, among the Harleian, Lansdowne, Cotton, and other MSS., or preserved with the public Rolls and Records of the State, it is made clear that at one period in the annals of this country mints were in operation in every town of any importance within its boundaries. Indeed, it is witnessed by coins still in a good state of preservation that, from about the close of the ninth to the middle of the sixteenth century, a practice prevailed of stamping the name or emblem of the town at which it was minted upon the face of each piece of money. Thus we

have proof positive of the existence of mints in early times in a variety of places.

No doubt those establishments were of very moderate extent, and the apparatus employed in the manipulatory processes performed within them, very primitive. It is certain, however, that a great amount of secresy was observed by those who were entrusted with the work of coining. Frequently we have found in examining the black letter records to which reference has been made that the words "mystery of the mint" occur, and there evidently was firmly implanted in the minds of both legislators and *monetarii* a horror of counterfeit coiners. It is probable that the mechanical appliances of each mint consisted principally of a hammer, a pair of shears, and a die. Much stress was laid upon the safe custody of the latter, the chief and essential element of mint apparatus in those days, and it may be considered as established by writs and indentures that each legal minter was entrusted with only one die.

As demonstrative of this fact, it may be mentioned that in many documents, and notably so during the reigns of John, Edward III., and Henry III., the numbers of the *monetarii* and *cunei* (dies), agree exactly. In one instance the king confirms to the Archbishop of Canterbury "tres monetarios cum tribus cuneis"; in another, the same monarch (Edward III.) grants to the monks at Redyng "unum monetarium, et unum cuneum" and in a third case the relation of mint and die is singulary indicated, for his majesty commands that the abbot of St. Edmund's be allowed to have in peace "the monetariam (*i. e.* officinam monetariam, or mint,) et cuneum (die) de S. Edmondo."

It is not improbable that only one denomination of coin was permitted to be coined by each minter, for, in A. D. 1743, we find a royal writ stating that the Bishop of Durham had from time immemorial enjoyed the privilege of coining "sterlings" or pence, but that he had never coined halfpence; and, finally, granting him a special license to coin halfpence as well as pence. Again, Cardinal Wolsey's offences in regard to his mint at York, which constituted the 40th of the articles of impeachment against him, A.D. 1529,* consisted mainly in "presuming to strike larger coins than his predecessor had done, and the daring to mark them as his own coinage by the stamp of the Cardinal's Hat."

It has not been often remarked, or at least it is not generally known that down to the middle of the sixteenth century there not unfrequently existed several distinct mints in the same town or place.

* Vide Ruding.

Until that period, if not even later, there were two mints inside the Tower of London. In the journal of Edward VI. (now in the British Museum) under date of the 10th of October, 1550, the king refers to "York, master of one of the mints at the Tower"; and on the 24th of September, 1551, his majesty, in the same journal, mentions not only "York's mint" but "Throgmorton's mint in the Tower." It is evident indeed that these two departments were distinguished as the Upper and the Nether Mints. Each of them was headed by its own under-treasurer, had its own staff of officers, and gave in distinct accounts of its operations.

During the reigns of Henry VIII. and Edward VI. while there were two mints in the Tower of London, there were two other wholly distinct mints without the Tower; namely one in "the manor of Suffolk House in the Borough of Southwark," and from which the notorious Mint Street of our own time takes its name, and another in "Duresme Place, in the suburbs of London," and where Durham Street, Strand, now by no means "in the suburbs," has since been formed.

Every one of these mints appears to have been presided over and worked by a single officer, with workmen under him, called myntere or minter in the Anglo-Saxon, and monetarius in the Latin records. This officer was singly responsible for the coin there minted, and paid his die-fees or die-rents.

From the seventh to the close of the thirteenth century it was customary for each minter to make himself directly responsible for the coins struck by him, by stamping his own name on every piece.

We have thus endeavoured to convey an idea of the system upon which the early mints of England were managed, and may now turn to the methods of coining practised therein. The very earliest specimens of coins of British manufacture were palpably the direct products of the melting-pot and the mould. Clay or chalk moulds, with the devices intended to ornament the money cut in intaglio upon their surfaces, were prepared; then a cylindrical vessel in which charcoal, most likely, was used as fuel, and forming a miniature smelting furnace, was provided, and these, with a few non-fusible "pipkins," for crucibles, a pair or two of tongs, a file, or cutting tool, scales for weighment of the metal, and some minor appliances, constituted the "machinery" of the earliest mints of Britain.

In the time of Athelstan, it is thought that this melting and pouring system was superseded by another, which, if it had not involved the use of engraved metallic tools or dies, would have been of nearly as simple a character. The melted bullion was now passed through

a kind of colander, or sieve—as in the modern plan of casting small shot—and the resulting globules of metal, having been placed on a stone and struck by a stamp with force of hammer, received blows which at once flattened, and impressed them with the rude devices intended as ornamentation. Some coins which evidently owe their appearance to this mode of manipulation are yet to be found in the cabinets of numismatists, and the same process is still pursued in several mints of India pertaining to its independent Princes and Rajahs.

Although the employment of iron, or steel stamps occasioned the engagement of smiths and die engravers in the Anglo-Saxon mints, yet the personal staff engaged in each, remained pretty nearly of as limited a nature as when the "pot and mould" system prevailed. "The die and hammer" arrangement existed for very many years, and the coins resulting from it are very hard, and present a sharpness of finish which cannot be communicated to cast money. In the small die museum of the Royal Mint, several coining tools or stamps of the kind just indicated, and belonging to a very early period, are still carefully preserved. This mode of minting was attended by many drawbacks, as for example constant meltings and great expense. It is unfortunate that the name of the ingenious individual who suggested and introduced the plan which immediately succeeded the globule system of money-making is unknown. It consisted, however, in the casting of cylindrical ingots or bars of some length, and of the exact diameters of the various sized coins which they were to yield. These, when cut as it were into slices, produced discs of silver or gold of about the thickness of the particular coin, and were "sized," or adjusted as to weight by aid of files and scales. When the planchets were thus obtained they were coined or stamped by being laid, one by one, upon a die firmly fixed on a block of wood or stone, and having a blow administered by another die and a hammer. Thus at a single stroke the obverse and reverse impressions were given to the intervening disc.

From the Red Book of the Exchequer quoted by Leake, it appears that the new money coined in the eighteenth year of the reign of King Edward I. was produced in the following manner: First the metal was cast into flat rectangular bars, very thin, and of some length. These were next cut into square pieces of the same size and weight, and which were afterwards trimmed and forged into circular form. After this they were made soft by annealing, and clean by boiling in acid. The impressions were then given by force of die and hammer as just described. It is difficult to see any advantage in this arrangement over that of casting cylindrical

bars and slicing them; but it seems to have remained in existence down to A.D. 1561. About this time Queen Mary consolidated the mints of England into one general establishment within the Tower of London, and it certainly was not until her reign that the custom of coining in the subordinate and provincial mints entirely ceased. The year 1561 is distinguished as witnessing the introduction of a remarkable improvement in the mode of manipulating money in this country. It was known as the "mill and screw," and to a Frenchman is due the merit of organizing it. The mill was worked by horses, and the metal thus rolled down to its proper thickness. When this was accomplished the planchets were punched out by small screw-presses, some of which latter are still in existence. Hammers and dies were still used for imparting the "image and superscription" of the monarch to the planchets. It is perhaps as well that the name of this Frenchman is forgotten, for after starting the new machinery he took to counterfeiting the money it produced, and being detected in the act, his career was terminated in a sudden and ignominious manner at Tyburn!

In 1629, a royal warrant was issued, authorising Nicholas Briot, then engraver at the Mint, to make trial in the Tower of his new method of coining money by mills and presses. What that method was is not known, for obstacles of an unsurmountable nature were placed in the way of its inventor, and it was never realised.

Peter Blondeau, another Frenchman, was more successful at a later period, for, in 1662, agreements were entered into with him to "furnish all the mills, rollers, presses, etc., necessary, and to instruct the minters or moneyers in the use of his newly invented tools, and engines for coining money." By these bonds the moneyers were compelled to pass the plates of gold or silver through the horse mill, "to cut, flatten, size, neale, blanch, and coin the pieces; to maintain the horses, to find alum, argot, and sawdust; to keep in repair the ovens, furnaces, and utensils for nealing and blanching; to make good the balances, small files, tubs, trays, bowls, and sacks," and to be accountable for all waste of metal in the various operations.

It will be seen by the conditions which the moneyers had to observe, and the lengthy inventory of appliances to be used by them, that at this time the art of minting in England had attained considerable development and importance. "Rule of thumb" in fact had yielded to scientific practice, and this of course has subsequently advanced the process of coining to a far higher state of perfection. With certain modifications of detail, Blondeau's system

of coining was practised in the mint within the Tower until that establishment, in 1810, was finally abolished. Since that date the coinage of the realm has been executed in the large establishment on Tower Hill known as the Royal Mint, and the machinery of which, propelled by steam power, was invented and erected by Messrs. Boulton and Watt, Rennie, Maudslay, Hall, and Napier, whose names, honourably known throughout the civilised world, are guarantees of its excellence. At a future time, it may be permitted us to describe in the pages of THE STUDENT the mode of coining now pursued at the Royal Mint, which is capable of pouring forth into the channels of circulation no less than 200,000 sovereigns per day, and these of such artistic beauty, and exactitude of individual weight, as to surpass the productions from any similar establishment on the face of the globe.

NUNDYDROOG; ONE OF THE HILL-FORTRESSES OF MYSORE.

BY BREVET-MAJOR G. E. BULGER, F.L.S., F.R.G.S., C.M.Z.S.

NUNDYDROOG, one of the hill-fortresses of Mysore, is considered to be about thirty-one miles from Bangalore, and the journey can, of course, be performed in a few hours. We, however, preferred making a three days' trip of it, and stopping at the different bungalows *en route*. Accordingly, starting about half-past six o'clock on the morning of the 9th of November—two of us driving, and the third on pony-back—the ten miles of distance between Bangalore and the first station, called Yellohunka, were accomplished in rather less than an hour and a half. The road thus far passes over an uninteresting plain, presenting nothing more picturesque than occasional small pyramids of granite boulders, and a few fine mango (*Mangifera indica*), bassia (*Bassia longifolia*), tamarind (*Tamarindus indica*), and other trees, standing either on the edge of the highway, or amidst the extensive bullar (*Lablab vulgaris*), and ragee (*Eleusine coracana*) fields, which, with a number of tanks and large plantations of some dwarf species of palm, cover the face of the country for miles.

The dak-bungalow contains only two small rooms, and is badly situated. It stands in a hollow surrounded by tanks and rice-fields, with a good many trees in close proximity, which not only harbour

myriads of mosquitoes, but exclude the air to a very considerable extent. The village is close behind, and from its low, swampy position, has a most feverish aspect. Here and there, in the neighbourhood, are straggling hedges, consisting chiefly of the agave (*Agave Americana*), the milk-hedge (*Euphorbia tirucalli*), and the Mysore thorn (*Cæsalpinia sepiaria*). The last-mentioned is a climbing shrub, somewhat renowned in the history of the country, for Hyder Ali surrounded his mud fortifications with dense hedges of it, and many of them still remain thick and close, as in the days when they formed such an important portion of that chieftain's skilful defences.

Next morning we continued our journey to Davunhully, thirteen miles further, and arrived about eight o'clock. This dak-bungalow is well placed in a fine, airy locality, and contains three rooms; but the man in charge had no crockery or cooking apparatus, and altogether seemed to be a stupid, helpless old fellow, without much idea of anticipating the wants of travellers. There is a large, straggling village close by, and an ancient fort of considerable size and strength. The country that we passed through appeared poorer and more sterile than that which we saw on the previous day. The vegetation was more scanty and more stunted; stones were more plentiful, and there was a greater preponderance of sand. A large mango-tope stands close to the bungalow, and a good many other kinds of trees adorn the road-sides and the little native gardens. In one of the latter we observed a most beautiful young specimen of the Pride of India (*Melia azedarach*). Its growth had been so regular that all the foliage was concentrated in an elegant umbrella-shaped mass at the summit; and the straight and gently-tapering stem bore much more resemblance to the graceful shaft of a betel palm, than the comparatively ungainly-looking trunk of an exogenous tree. S—— also found a large specimen of the beautiful and fragrant *Nyctanthes arbor-tristis*, "the sweet night-flower," that Moore has immortalized in "The Veiled Prophet of Khorassan," as the sorrowful nyctanthes, which begins to waft its rich odours after sunset:—

> "When darkness brings its weeping glories out,
> And spreads its sighs like frankincense about."

The trunk of this specimen was fully four inches in diameter.

On the third morning, we left Davunhully about six o'clock, and reached the foot of Nundydroog, distant eight miles, in about an hour and a half, having passed through a more picturesque country

than before, but still, for the most part, very flat and apparently very barren. By this time the sun was getting hot, and we were not sorry, after clambering up the steep sides of the mountain, to experience the cool breeze that always seems to sweep round the lofty summit. There is a winding road of between four and five miles in length, by which travellers can ride the whole distance from the base, if they wish; but we followed the shorter and more precipitous foot-path up the side.

Nundydroog Hill is the highest of three granite rocks, possessing a mean elevation of about 1500 feet above the plain, which stand close to one another in about 32° 22′ N. lat., and 77° 45′ E. long. The fort upon its summit was built by Hyder Ali upon the ruins of an earlier fortification of the Polygars, and must have been immensely strong, judging from the works that still remain. The rock, whose altitude is 1760 feet above the plain beneath, and 4856 feet above the sea level, is almost inaccessible for a great portion of its circumference, and completely so in many parts, where it is girt with precipices between 1000 and 1200 feet in height. One of these, known as Hyder's Drop, is said to have been barbarously used by that prince for the execution of his prisoners, who were sewn up in sacks, and rolled over amongst the broken rocks beneath. The only assailable portion of the fortification was defended by a double line of ramparts, partly composed of a kind of small brick, burnt so hard as apparently to be almost impenetrable. The ascent in every part is very steep, and it seems almost incredible that it should have fallen to the British so easily as it did, when attacked by a small force under Major Gowdie in 1791. It is recorded that the storming party, the outer wall having been breached, succeeded in following the defenders through the inner gate before they could close it, and thus captured the place with the loss of only a few men.

The circumference of the hill at its base is said to be twelve miles, and that of the works on the summit one-fourth of that distance. The two adjoining mountains are at present uninhabited, and from their barren, inhospitable appearance, are likely to remain so. That to the eastward of Nundydroog is called Baynes's Hill, in consequence of a captain of that name, when stationed below, having built a bungalow upon the summit. The bungalow is now in ruins and the place deserted.

The prospect from the summit of the droog is, in consequence of its lofty and almost isolated position, most curious and extensive, embracing the greater portion of the Mysore table-land, which,

although usually spoken of as a plain, abounds in naked rocky hills of various altitudes, seldom reaching, I should imagine, above 1000 feet over the level of the plateau, and being, in most instances, considerably below that elevation. Most of the larger ones have fortifications on their summit, hence the name *droog*, from the Sanscrit *durga*, a strong fort, by which they are commonly designated. They are, for the most part, isolated masses of gneiss or granite, shooting up abruptly from the plain, and apparently almost destitute of vegetation. The number of tanks visible from the top of the Nundy Hill is almost incredible: I counted a hundred and fifty, which I feel certain is below the actual number. Villages, too, are of course abundant, but, from their colour, they are inconspicuous.

Two or three mornings after our arrival, an extraordinary sight presented itself. A thick mass of clouds overspread the whole of the plain below us, and completely obscured the view of the land in every direction. From our lofty position, considerably above them, they had exactly the appearance of the ice-fields of the Polar regions, as we see them depicted in works of travel. In a short time the wind and sun dispelled the whole of this singular prospect, which was as fleeting as it was curious.

The present hotel at Nundydroog is a noble building, and was ormerly the residence of Sir Mark Cubbon, who owned the land, and who constructed this famous hill-residence for himself. There are some three or four other bungalows upon the mountain, but the hotel crowns the very summit, and possesses by far the finest site for many miles around. It is within the walls of the old fort, and has a capital garden attached, which is on the slope of the hill, and shaded, for the most part, by beautiful jamoon trees (*Syzygium jambolanum*). Here I observed orange and coffee plants, with other tropical and semi-tropical productions, growing amidst hundreds of English flowers, which seemed to thrive in the pleasant gloom of this pretty spot. There are two large tanks in close vicinity, and, apparently, all other accessories to comfort and convenience. The hotel is exceedingly well managed, and only requires to be more generally known to be fully appreciated.

Notwithstanding the limited size of the mountain-summit, there are a number of mazy footpaths round the works, and through the jungle that now partly covers them, which afford pleasant walks to the lover of nature, or even to the pedestrian, whose "wind and limb" are not sufficiently good to induce him to walk down the hill and up again, as C—— was in the habit of doing in the small

hours of the morning, before either S—— or I was thoroughly awake. One of these tracks, known as "the monkey-path," from its having been made and used, I believe, exclusively by those animals, is quite dangerous enough to test the head and climbing qualifications of a member of the Alpine Club.

Besides the hotel and bungalows already mentioned, there are various other buildings upon the mountain, which, I suppose, were occupied in olden days by the servants and retainers of Sir Mark Cubbon; and there are also older structures, consisting of temples, reservoirs, etc., which evidently date from an earlier period; probably in some cases prior to the occupancy of the place by Hyder and his family.

Colonel Welsh remarks, in his "Military Reminiscences," that a certain spring at Nundydroog is said by the natives to be the source of the Penaur, or Punoar River; but we could neither identify the spring, nor glean any information concerning it.

At the time of our visit, although the gardens were rich in the bloom and fragrance of mignonette, *Aloysia citriodora,* heliotrope, carnations, wall-flowers, and violets, few wild plants were in blossom; and the low jungle, which fills up the gorges between the hills, and wherever there is soil enough upon the hill-sides to give it nourishment, was, therefore, comparatively uninteresting to the botanist. On the lower slopes, however, the singular-looking *Kalanchoe floribunda* attracted attention; and over the crests of some of the broken walls *Hedera obovata* spread its straggling but lovely branches in such thick, heavy masses, as to enhance greatly their picturesqueness and their beauty. The pretty little *Clausena Willdenowii,* with its half-ripened crimson berries, and the curious *Rottlera tinctoria,* were both growing in the garden, and on the sides of the hill; the former so profusely as to suggest the idea of its being indigenous, while, further down, all the commoner plants of Mysore were to be found in abundance.

I did not notice many birds during my short stay, and, with the exception of the Alpine and common Indian swifts (*Cypselus melba et affinis*), very few individuals of the species observed. These were the common scavenger vulture (*Neophron percnopterus*) the common kite (*Milvus govinda*), the blue rock-pigeon (*Columba intermedia*), the common ring-dove (*Turtur risoria*), the blue rock-thrush (*Petrocossyphus cyaneus*), of which I saw only one specimen, and the white-headed babbler (*Melacocircus griseus*). I think I saw both *Hirundo daurica* and *Cotyle concolor,* but am not sure;

and I am equally uncertain as to the identity of some of the smaller birds which I met with.

The vicinity of Nundydroog is reputed to furnish the best potatoes in the peninsula, and is also celebrated for its sugar, which is said to be of superior manufacture. I did not, however, either taste or see any of the former, and I certainly did not think the latter deserving of any special mention.

THE NOVEMBER SHOOTING-STARS.

BY R. A. PROCTOR, B.A., F.R.A.S.

(With a Tinted Plate.)

ALTHOUGH there was no display of the November meteors last year in any part of Europe, yet the calculations of astronomers respecting the hour and character of the star-fall accorded very closely with the results actually observed. In the West Indies and in North America the display was well seen, and from the hour at which the maximum occurred, it is readily calculated that had the morning of November 14th, 1867, been clear in England, we should have seen the commencement of the display, but not its more brilliant part. The maximum would not have been visible in our latitudes further east than the middle of the Atlantic. The mean of the hours which observers in America and the West Indies assigned to the occurrence of maximum display, differed less than two hours from the calculated epoch, a correspondence which must be looked upon as highly satisfactory when it is remembered that our new views respecting the nature of the meteor-zone are such as largely to enhance the difficulty of predicting the hour at which the display should occur.

Further, it is clear from the evidence which reached us from America that the part of the zone of meteors through which the earth passed last November was very little inferior in the density of meteoric aggregation to the portion passed through in November, 1866.

The most satisfactory news which reached us respecting the shower of 1867 was included in three letters, one from Commander W. Chimmo, who observed the shower off Martinique, another from Captain Stuart, who observed the shower at Nassau, and the third

from Professor Daniel Kirkwood, who observed the shower at Bloomington, Indiana.

Commander Chimmo, while sitting on the bridge of H.M.S. Gannet, saw an immense number of bright sparks falling into the sea, apparently close to the ship. "I thought they came from the ship's funnel," he writes, "because they resembled the sparks caused by the burning of wood." But having seen a brilliant meteor bursting in the east, he called the attention of the First Lieutenant and Master to the phenomenon. These officers were on the bridge at the time, and they saw that the meteoric shower was falling rapidly and perpendicularly, a brilliant meteor every now and then bursting and illuminating the whole heavens. The spot of cloud from which the meteors fell was only about one-sixteenth part of the whole heavens, a heavy nimbus cloud covering the rest of the sky. Commander Chimmo was unable to make distinct observations because the ship was just entering a strange harbour, and he and his officors were obliged to withdraw their attentiou from the progress of the display. He states, that at Trinidad the shower was much better seen, no less than 2000 meteors having been observed between two A.M. and daylight. The meteors were numerous in the N.E., as seen from Trinidad, and described arcs of 60 degrees. Some were reddish, others green, and one of a bright fiery purple.

Now, there are several points in Commander Chimmo's observation which are well worthy of comment. First, he saw the meteors falling perpendicularly. This is very different from what happened when we were watching the display in England on November 14, 1866. But when the aspect of the sidereal vault is calculated for Martinique at the hour of Commander Chimmo's observation (about half past five in the morning), it appears that the radiant-point was very close to the zenith, so that all the meteors would seem to be falling perpendicularly towards the horizon. Again, from the splendour of the display, seen by Commander Chimmo, it may be concluded that he watched the shower nearly at the epoch of maximum intensity. This is confirmed also by what he states respecting the star-shower seen at Trinidad, for although 1600 meteors were seen there between two A.M. and daylight, only 693 were counted before half-past five A.M., and very soon after six o'clock the approach of daylight must have put an end to the display; so that within less than an hour upwards of 900 meteors must have been seen.

Captain Stuart, at Nassau, observed the display under more favourable circumstances. For Nassau lies 16° 11′ further west

than Martinique, so that the hour of maximum display occurred one hour earlier as respects local time. From Captain Stuart's statistics we may judge that he saw the star-shower from its true commencement to its true end. In other words, the commencement of the shower, as seen by him, was not due to the circumstance that Nassau was coming round from the sheltered to the exposed half of the earth's globe, but to the fact that the earth had begun its passage through the meteor-zone; and, in like manner, the termination of the shower, as seen by Captain Stuart, was not caused by the coming on of daylight, but by the fact that the earth had passed through the meteor-zone. This is an important circumstance. In England, in 1866, we did not see the true commencement of the display, though the weather was clear throughout the night of November 13-14. When the earth really began to pass through the meteor-band on that night I have not been able satisfactorily to determine. The news we had from Kishnagur showed that the display had begun at ten P.M. (Greenwich time) on the night of November 13, at which hour England was on the sheltered half of the earth. But the observer who sent us the account of the display, as seen from Kishnagur, did not see the commencement of the shower, having only begun observing when the shower was already in progress. I was in hopes that before now I should have been able to state the true hour at which the display began, as a pupil of mine informs me that he was marching at the head of an Indian survey-party throughout the greater part of the night of November 13-14, and noted in his diary the hour at which the display began. But he has as yet been unable to obtain the book from India. There can be little doubt that in India the true commencement of the shower was visible.

It follows from the mere fact that Captain Stuart saw both the true beginning and the true end of the display that the part of the zone traversed by the earth in November, 1867, was considerably thinner than the part traversed in 1866. The following table exhibits the most important of his results. It must be noticed that the observer, an intelligent nautical man, "was not favourably placed for an extensive view of the heavens," and two other observers counted no less than 1100 meteors between 2h. 30m. and 4h. 45m., up to which hour Captain Stuart had counted only 800:—

[illegible] the hour of maximum display centred [illegible] From Captain Stuart's [illegible] stars shower [illegible] its true commen[illegible] other words, [illegible] commencement [illegible] was not due to the circumstance [illegible] the [illegible] the [illegible] to the fact that the earth had begun its [illegible], and, in like manner, the ter[illegible] seen by Captain Stuart, was not caused [illegible] but to the fact that the earth had [illegible]. This is an important [illegible] we should not [illegible] weather was [illegible] When the earth [illegible] began to pass [illegible] on the night [illegible] and satis[illegible] The news we had from Kish[illegible] showed [illegible] began at [illegible] time) on the [illegible] 13, at [illegible] England was on the sheltered [illegible] account of the [illegible] did not see the commencement of [illegible] the shower, was [illegible] before [illegible] which the [illegible] was [illegible] at the [illegible] greater part of the night [illegible] the hour at which the [illegible] to obtain the [illegible] the true com[illegible]

[illegible] follows from [illegible] that Captain Stuart saw [illegible] the morning [illegible] of the display that [illegible] the stone [illegible] in the November, [illegible] the part [illegible] The following table exhibits the [illegible] important [illegible] be remembered that the obs[illegible] was not favourably placed for an extensive view of the heavens, and two other [illegible] counted no less than 1100 meteors between [illegible] up to which hour Captain Stuart had counted only [illegible]

ORBIT OF THE NOVEMBER METEORS.

E E′, Orbit of the Earth. M M′, Orbit of Mars. J J′, Orbit of Jupiter. s s′, Orbit of Saturn. U U′, Orbit of Uranus.

OBSERVATIONS OF THE METEORIC SHOWER OF NOVEMBER 14, 1867, taken at Nassau, N. P. Bahamas (Lat. 25° 5′ N., Long. 77° 22′ W.), by Captain Stuart, Deputy Inspector of Lighthouses.

Local Time.	Proportion of Sky Clear.	Length of each Period.	Number of Meteors seen in each Period.	Total from Commencement.
A.M. Before 3 0	.5	...	...	45
3 15	...	15	52	97
3 30	...	15	32	129
3 40	...	10	34	163
3 50	.6	10	49	212
4 0	...	10	118	330
4 10	...	10	125	455
4 15	...	5	102	557
4 20	...	5	73	630
4 25	...	5	69	699
4 30	...	5	66	765
4 35	...	5	21	786
4 40	...	10	52	838
4 50	...	10	64	902
5 0	.8	10	65	967
5 10	...	10	22	989

There is a mistake somewhere in the published table, the first and third columns not corresponding exactly together. However the mistake, wherever it may be, is unimportant only affecting a five-minute period, and I believe that the above modification of the table represents what the published table was intended to express.

It will be seen that the epoch of maximum display occurred somewhere between 4h. 15m. and 4h. 20m. A.M., Nassau time, say at 4h. 18m. This corresponds to about half-past nine, Greenwich time, and it will be remembered that astronomers in England assigned half-past seven as the hour of maximum display.

Captain Stuart's account is confirmed by the statements of Professor Kirkwood. Assisted by Professor Wylie, and several students, he kept watch for meteors from 9h. 15m. P.M. to 5h. 15m. A.M., at the Indiana University, Bloomington. The night was very unfavourable for observation, the sky being obscured by so dense a haze that scarcely any fixed stars, except those of the first magnitude, were visible. It is remarkable that under such circumstances any shooting-stars should have been seen at all, and we may

fairly conclude that, had the night been favourable, a display equalling, if not excelling, that which we saw on November 13-14, 1866, would have been observed by the Professor and his fellow-watchers. The results actually observed were as follows :—

November 13,	from	9h. 15m.	to	12h. 0m.,	1	meteor.
„ 14,	„	0h. 0m.	to	3h. 15m.,	75	meteors.
		3h. 15m.	to	4h. 15m.,	351	meteors.
		4h. 15m.	to	5h. 15m.,	98	meteors.

The time is Cincinnati time, differing from Greenwich time by about 5h. 38m. "It will be noticed," says Professor Kirkwood, "that 351, or two-thirds of the whole number seen in eight hours, were observed between 3h. 15m. and 4h. 15m. The maximum occurred about 3h. 45m., when the rate was twelve per minute. All the meteors, with one or two exceptions, were conformable" (that is, belonged to the November shooting-star system). "Two or three were sometimes seen simultaneously, and a tendency to appear in clusters was distinctly noticed. A very remarkable meteor was observed in Leo, a little above the Sickle, at about 3h. 40m. It was stationary, and continued visible between two or three seconds. It was at first small, but increased rapidly in magnitude, until, just before extinction, it surpassed Regulus, the only star in the Sickle then visible through the haze. This meteor was undoubtedly near the radiant."

The epoch of maximum display assigned by Professor Kirkwood corresponds to 9h. 23m., Greenwich time, and, therefore, agrees very closely with the result we have already deduced from Captain Stuart's observations. This agreement is the more remarkable, because Nassau is upwards of 1200 miles from Bloomington, so that the meteors seen in the two places belonged to different parts of the meteor-band. The agreement in the position of the region of densest meteoric aggregation, indicates a stratification of the meteor-system, and corresponds, therefore, with the views respecting its structure, which I put forward in the paper referred to below.

But now we have to consider some very remarkable conclusions which flow from a comparison of the observations made upon the November meteors in the years 1866 and 1867. So long as it was supposed that the band of meteors held a position in space nearly identical (save as respects the inclination of the meteoric orbits) with that of the earth's orbit, it was easy to explain the occurrence of showers in two, or even in three, successive years, without assuming a very remarkable extension of the meteoric cluster to which the

more striking displays were supposed to be due. This cluster was supposed to circle around the sun in a period either slightly exceeding or slightly falling short of a year, so that after one nearly central passage, the next encounter between the earth and the meteor-system would take place not very far on either side of the region of densest aggregation. We say not very far, and it will be seen presently that the expression is justified when the real dimensions of the meteor-cluster come to be compared with those we are considering. But, in fact, the distance between the points at which the earth was supposed to cross the meteor-system in successive years was very little less than the 33rd part of the circumference of the earth's orbit, so that the space we have spoken of as *small*, really amounted to about fifteen millions of miles.

But now let us consider the true figure of the meteor-orbit. We suppose that most of our readers are familiar with the evidence which has led astronomers to recognize the fact that the meteors travel in a period of 33¼ years. We have not space even to summarise the process of inquiry pursued by Adams—for to Adams alone is due the discovery in question—but we may remark that the result he obtained is not a dubious one. Those who understand the nature of the problem he dealt with, and the exact manner in which mathematical analysis enables us to deal with such a problem, know that the agreement between the nodal shifting of the meteor-band with that due to an orbit having a 33¼ years period, is sufficient to prove beyond a doubt that this period is the true period of the system.

Once the period is known, it becomes at once possible to estimate from the assigned position of the radiant-point the true direction in which the meteors cross the earth's orbit, and thence the exact position of the orbit. In this part of the work, a part which is within the powers of very inferior mathematicians, Professor Adams was anticipated, we believe, by Leverrier, his co-labourer of old, and by others. A slight difference exists between the results obtained by different mathematicians—a difference wholly due to the different radiant-points they adopted. Taking Adams's results, founded on the supposition that the radiant-point was situated in R.A. 149° 12′, and N. Dec. 23·1, we have the following elements for the meteor-system :—

Period	33·25	years (assumed).
Mean distance . . .	10·3402	
Eccentricity	0·9047	

Perihelion distance . . .	0·9855
Inclination	16° 46′
Longitude of node . . .	51° 28′
Distance of perihelion from node	6° 51′

Motion retrograde.

Schiaparelli's results differ very little from these, save as respects the two following elements:—

Inclination	17° 44′
Distance of perihelion from node . . .	4° 57′

It is important to notice that a very trifling difference in the assumptions made with respect to the position of the radiant-point, affects these two elements appreciably.

The figure represents the orbit of the November meteors, according to the estimate of Professor Adams. E E′ is the earth's orbit, crossed by the meteor-system, at the point marked ☋, which indicates the descending node of the meteoric orbit upon the ecliptic. The perihelion of the meteor-system is at *p*, the aphelion at *a*. The orbits of Mars, Jupiter, Saturn, and Uranus are indicated by the letters M M′, J J′, *s s*′, and U U′ respectively. The arrows indicate the direction of the orbital motions. It must be observed that the portions of the orbits of Jupiter, Saturn, and Uranus are laid down with their proper eccentricity. For instance, the centre of the arc U U′ is at *u*, not at S. The eccentricity of the orbit of Mars will be obvious at once. The line ☋ ☊ is that in which the plane of the meteoric-zone intersects the plane of the ecliptic. It will be noticed that the ascending node lies close to the orbit of Uranus. This approach to coincidence came out exactly as represented, by the mere process of careful construction. As there is every reason to believe that the introduction of the meteors to their present position was due to their having approached Uranus very closely (the epoch assigned by astronomers to the appulse is A.D. 126), it, of course, follows, that their orbit ought to indicate an agreement of this sort—for, having once assumed an orbit through the attraction of Uranus, they were compelled from that time forth always to pass, once in each revolution, through the point at which the encounter took place.

The part of the meteor-orbit below the line ☋ ☊, in the figure, is supposed to lie above the plane of the paper, the remaining part below that plane. The lines tipped with arrow-heads indicate the amount by which the orbit is depressed below or raised above the

ecliptic-plane on the scale of our figure. In this indication only the part of each line between the two cross-lines is to be considered. It will be noticed that when these effects of the inclination of the meteoric orbit are attended to, the orbits of Jupiter and Saturn are found to pass at a considerable distance from the meteoric orbit; in fact, neither Jupiter nor Saturn can ever approach the meteors at a less distance than about eighty-five millions of miles, even at those points where, in the figure, the orbits of these planets appear to intersect the meteoric orbit. Mars, in like manner, cannot approach the meteors by a less distance than twelve or thirteen millions of miles.

The division-marks round the orbit of the meteors indicate the arcs over which they pass in successive years, starting from p. Thus, in one year a meteor will have reached the point 1, in two the point 2, and so on; and it will pass the aphelion-point, a, after sixteen years and five-eighths have elapsed from the epoch of perihelion-passage. It will be observed, that the rate of motion in aphelion is very much less than the rate in perihelion; in fact, in one year after perihelion-passage a meteor traverses upwards of five hundred millions of miles, whereas, in one year near the aphelion-passage a meteor travels over about forty-five millions of miles only.

In connection with the points marked 1, 2, 3, 4, etc., I have a somewhat amusing anecdote to relate. A very eminent astronomer was desirous of drawing a figure corresponding to that presented in my illustrative plate. But he was so accustomed to abstruse mathematical investigations that the simple processes of construction which a far inferior mathematician would make use of—those, for example, which I used in constructing the figure of the orbit—did not occur to him. Instead, therefore, of laying down the ellipse from its known axis major and eccentricity, he adopted a very novel and somewhat laborious process, corresponding to the process of breaking a butterfly on the wheel. He actually *calculated* every one of the points marked 1, 2, 3, etc., deducing the radius-vector and eccentric anomaly, in each case, by a complicated process of approximative calculation, and then, when he had marked in all these points, he took his ellipse through them. It is as though a sum in addition were worked by the differential calculus. Nor was the resulting ellipse worthy of the elaborate processes applied to its construction, being palpably irregular—not to say "wobbly;" in fact, intervals of a few weeks, instead of a year, ought to have been taken near p to give the true figure of the ellipse.

I believe that the figure which accompanies this article is the

first in which the true relation of the meteoric orbit to the orbits of the planets (properly eccentric) has been exhibited with any approach to exactness.

If Schiaparelli's elements be adopted, the line, *p a*, would have to be shifted around S, through an angle of about two degrees, the end *a* moving downwards.

The readers of THE STUDENT will scarcely need to be reminded, that the orbit of the November meteors has been found to exhibit a very close accordance with that of a telescopic comet discovered by Tempel, early in 1866. The extent of the agreement will be perceived by comparing the following elements of the comet with those assigned above to the meteoric orbit:—

Period	33·18 years.
Mean distance	10·3248
Eccentricity	0·9054
Perihelion distance	0·9765
Inclination	17° 18′
Longitude of node	51° 26′
Distance of perihelion from node . .	9° 2′
Direction of motion	Retrograde.

These are the elements assigned by Dr. Oppolzer. It will be noticed, that the inclination lies between the values assigned by Adams and Schiaparelli to this element. The distance of the perihelion from the node differs 2° 11′ from Adams's estimate, and 4° 5′ from Schiaparelli's. A very slight difference in the assumed position of the radiant points of the November meteors would have brought these elements into perfect agreement. The period of 33·25 years assigned to the November meteors accounts for a large proportion of the remaining discrepancies, which, however, are exceedingly minute as it is; in fact, the *figure* of the orbit assigned to the comet would correspond so closely with that assigned to the November meteors in the plate, that it would not be possible to distinguish one from the other on the scale of that figure. The difference of *position* would correspond to a shifting of the line, *p a*, around S, the end, *a*, moving upwards, through an angle of 2° 11′. The latter difference is one which could be wholly accounted for, not only by assuming a very minute error in the determination of the radiant-point of the November shooting-stars, but by assuming very slight errors in the observations made upon comet I., 1866, during the time that it continued visible in our skies. No reasonable doubt can exist that the meteors and the comet form a single

system. And, by the way, it is worth noticing, that as the comet passed its perihelion early in January, 1866, it had travelled the best part of the way towards the point, 1, in November, 1866; so that we passed through a point (☋) removed some four hundred millions of miles from the nucleus of the comet. In 1865, on the contrary, the earth passed through a point much nearer to the head of the comet, but in advance of it.

And now let us consider for a moment the actual volume of the space which is occupied by cosmical bodies, aggregated with greater or less density, and forming what we now know as the November meteor-system. In the first place, we must, I think, dismiss the notion that there are gaps or breaks in the system. A consideration of all the well-authenticated observations which have been made upon the meteors suffices to show that, although there are variations in the density of meteoric aggregation, and also in the thickness of the ring of meteors in different parts of its circumference, yet these variations take place in a continuous manner; in other words, there are neither sudden increments nor sudden decrements in the density of meteoric aggregation.

We have, then, a ring of meteors, forming an ellipse of the figure presented in our illustrative plate. The major axis of this ellipse is about eighteen hundred and eighty-five millions of miles long; its circumference little less than forty-four hundred millions of miles long. The ring is probably flattish, but is certainly variable in thickness. What its width may be we cannot tell. Our supposition that the ring is flat involves, of course, the conclusion that the width of the ring is greater than the thickness, and we think there can be very little doubt on this point. The disturbing forces to which the ring is subjected are such as must tend far more to an increase of width than to an increase of thickness. In a paper which appeared in the "Intellectual Observer" for October, 1867, I pointed out that the consideration of the phenomena presented during the display of November 13-14, 1866, sufficed to show that the portion of the meteor-system through which the earth then passed was certainly not less than 100,000 miles thick, and 6,000 miles broad. We may fairly assume that the breadth of that part of the ring is some million or so of miles. Now, we have seen that the part of the ring traversed in 1867, although quite as densely crowded with meteoric bodies, was not so thick as the part traversed in 1866. Applying the same method to the determination of the thickness that I used in the latter case, we obtain a thickness of about 60,000 miles. We may fairly assume a breadth ten times as great. Further,

the part of the ring we passed through in 1866 had moved off upwards of 530,000,000 miles in November, 1866. The whole of this long arc was occupied by a portion of the ring, which we may suppose to have thinned off gradually from a thickness of 100,000 miles, at one extremity, to a thickness of 60,000 at the other. Assigning to it a mean thickness of 80,000 miles, and a mean width ten times as great, we obtain for the volume of the portion of space thus shown to be occupied by meteors the following imposing dimensions :—

$$80{,}000 \times 800{,}000 \times 530{,}000{,}000 \text{ cubic miles;}$$

that is, no less than thirty-four millions nine hundred and twenty thousand millions of millions of cubic miles!

We have spoken of densely aggregated meteors in dealing with that portion of the system which supplies brilliant star-falls. But this term must be understood relatively, not positively. Even the appearance of ten or twelve meteors in a second, which would correspond to a very brilliant shower, would not indicate a very close aggregation of the members of the meteoric system; for, in a second the earth passes over eighteen miles, and the meteors traverse about twenty-five miles in the same period.* Hence, making due allowance for the inclination of the meteoric orbit, we find that an interval of one second corresponds to the passage of the earth through about forty miles of the meteor-system; and twelve minute bodies along a line of forty miles, could hardly be said to be very closely aggregated. But this would correspond to the case of all the twelve meteors appearing in exactly the same part of the heavens. As, in fact, they appear in different parts, we must further take into consideration the circumstance, that meteors may be visible simultaneously at places removed some 1,500 miles from each other; in fact, the consideration of the plate accompanying my paper on the November meteors, in the "Intellectual Observer" for October, 1866, will show that our twelve meteors must be supposed to be contained within an elliptical tubular space, the length of the tube being forty miles, the major axis of the ellipse 1,500 miles, and the minor axis varying according to the hour of display. As the weight of twelve November meteors would in general hardly exceed ten or twenty pounds, we can see that the mean density of the meteoric ring is indefinitely small even in the richest parts of the system.

* The following simple formula is convenient for determining the relation between the velocities (v and v') of two bodies at the same distance r from the sun, and travelling in orbits having mean distances a and a' respectively.

$$v^2 : v'^2 :: 2aa' - a'r : 2aa' - ar.$$

Space will not permit to dwell, as I should wish to do, upon the startling considerations suggested by the examination of the November meteor-system. Wonderful as is the scale of the system itself, it is rather what the system suggests respecting the interplanetary spaces which most strikingly attracts our attention. Look at the orbit of the ring, as pictured in our illustrative figure, and consider how minute the *à priori* probability that the earth should encounter such a ring of meteors, if there were but one. The chances may be reckoned at millions on millions to one against encounter. And therefore the chances are millions on millions to one that there is more than one such ring, and the balance of probability is in favour of there being millions of such rings. We know that this ring presents no sign of its existence (save at the epoch of encounter), even in the most powerful telescope. We know, also, that the comet which is associated with it has escaped detection for hundreds of years, and might very well have escaped detection for many more hundreds. Therefore we may safely assume that, in the mere non-detection of any signs of the existence of other meteor-rings, there is absolutely no argument whatever against the theory (in itself a highly reasonable one) that there are millions of rings similar to the November meteor-system. But we must refrain from pushing further the speculations suggested by theories of this sort.

Many of our readers will, doubtless, be anxious to know what prospect there is of a display of meteors being visible on the 14th of November next. We fear there is but little. Calculating from the display of 1866, we should assign half-past one or a quarter to two (in the afternoon) as about the hour at which the earth will pass through the richest stratum of the ring-system. Calculating from the display of 1867, we should assign half-past three or a quarter to four as the hour of passage. At either epoch England will be upon the sheltered hemisphere of the earth.

In fact, it is not likely that the display will be well seen by practised observers anywhere. In New Zealand it may be seen, though the position of New Zealand on the earth's southern hemisphere is unfavourable (for reasons suggested in my paper already referred to). It is possible that a few travellers who may happen to see the phenomenon from various parts of the Pacific in which (if the views above expressed be correct) the display will be visible, may think it worth their while to report their observations. On the whole, however, it is more probable that we shall hear nothing of the November shooting-stars of the year 1868.

It is just possible that the form of the ring-system may not be

so regular as we have been supposing. In this case the hour of display would not correspond to the above calculation, and we might even see the shower in England. The chance of its occurring on the morning of the 14th is about equal to that of its occurring on the morning of the 15th of the present month, and observers should therefore watch for meteors on both nights.

STATE AID TO SCIENCE.

A QUESTION of great importance was brought before the British Association, at its recent meeting, by Lieut.-Col. Strange, in a paper "On the Necessity of State Intervention to Secure the Progress of Physical Science;" and a committee was appointed, consisting of Lieut.-Col. Strange, Professors Sir W. Thompson, Tyndall, Frankland, Williamson, Stokes, Fleming, Jenkins, Hirst, Huxley, Dr. Stenhouse, Dr. Mann, Messrs. Glaisher, Huggins, and Dr. Balfour Stewart, to consider and report upon the subject.

Political and social philosophers are tolerably unanimous in the opinion, that the government, or central power of the state, should not undertake any work which can be as well, or better, accomplished by individual exertion or by private association. This rule places a limit to governmental action, although the boundary is not clearly defined, or constant in its position, and it is incumbent upon those who invoke state intervention to show that very strong and sufficient reasons for it exist. But while there is a desire to circumscribe the functions of government in certain directions, there is an opposite and equally powerful disposition to extend them in others. As civilization advances, and political liberty extends, hostile distinctions between governments and people pass away, and nations tend to organize themselves as great co-operative societies, turning the central power in any direction consistent with individual rights, and likely to be productive of general good. There ought to be no fear of investing properly constituted governments with too much power of being useful, though there may be great necessity for constituting efficient safeguards and checks against abuse. Human progress is not likely to diminish the sphere of state action, but, on the contrary, to increase it; and if any one comes before the public with proposals that the government should undertake certain new functions, the following inquiries should be made:—First, Is the thing proposed desirable in itself? Secondly, Can it be efficiently,

and with sufficient promptness, accomplished by individual exertion or private co-operation? And, Lastly, Is the work of a nature that governmental machinery could satisfactorily perform?

Colonel Strange's paper has reference to government aid to secure the *progress* of physical science. He passes over the diffusion of existing knowledge, as belonging to education, a subject on which he expresses a strong interest, but which he does not touch. No one now doubts that the state ought to make ample public provision for national education, and that the physical sciences must occupy an important place in any scheme worthy of acceptance and support, but in the discharge of educational functions the state would only be an instrument for promoting mental and moral cultivation, and for distributing knowledge already acquired. This is a most important duty, but it is only indirectly or incidentally connected with the advancement of science and the progress of discovery. The more elementary scientific education is diffused amongst the people, the larger we may expect to find the number of persons who will be capable of making new and original investigations, and society will gain by their exertions, provided it supplies them with adequate incentives and sufficient means.

At present there are two great hindrances to the utilization of the scientific capacity which the country actually possesses; one is, the fact that devotion to pure science is, in the absence of private property, a condemnation to poverty, if not to absolute want; and another is, that only a few of those who possess both the capacity and the inclination can obtain the means of carrying on the researches they would wish to make. Colonel Strange justly observes, "Science can no longer be cultivated as in by-gone time it used to be. In astronomy, the man with his table spy-glass cannot now furnish acceptable results. In chemistry, the Wollaston tea-tray and wine-glasses are superseded by well equipped laboratories. In optics, we see elaborate spectroscopes, not Newton's simple prism. In meteorology, and in every investigation of continuous phenomena, we are satisfied with nothing less than self-recording instruments. In electricity, in microscopy, and in other branches, our appliances are every day more and more amplified. The age of great discoveries made, and, above all, extensive series of facts accumulated, with limited means, is passing away, and we are every day compelled to employ more perfect appliances and more systematic agencies in unravelling the secrets of nature." Every practical worker in science will feel the truth of these remarks, and the general public need only a little information to perceive their force.

In the progress of science, the early steps consist almost entirely of *qualitative* results. Let us take chemistry for an example. The first thing to be done was to distinguish between substances easily accessible, and whose properties had not been ascertained. The early chemist who compared the more obvious properties of iron with those of copper was an important discoverer, and he who first melted copper and tin together, and formed bronze, was a very efficient contributor to the world's progress in the applications of science.

Nearly a hundred years ago, Dr. Priestley made his remarkable series of discoveries in gaseous chemistry, but his researches, though extremely able, were all *qualitative,* and he missed truths of the highest importance, because he neglected to ascertain the *quantities* of the results obtained in his varied experiments. Even *rough* weighing, as it would now be considered, would have led him to abandon the phlogiston theory, and to have anticipated the proofs of its fallacy, that were supplied by Lavoisier and Scheele. When a metal was burnt in air or oxygen, Priestley explained the process according to the theory of Beecher and Stahl, although his own discovery of the latter gas supplied the means for its overthrow. Weighing the burnt metal which, in conformity with existing opinions, he thought had lost its phlogiston, would have shown that instead of a loss there had been a gain of something, and weighing the residual oxygen would have shown what the metal had acquired. Modern chemistry is founded upon the accurate ascertainment of quantities in analyses and combinations, but the apparatus that sufficed for quantitative discovery in the days of Lavoisier and Scheele is now replaced by contrivances much more elaborate, far more delicate, much more costly, and only capable of being efficiently used in rooms or buildings specially contrived. The manipulative skill required for accurate quantitative analyses is so great as only to be acquired by long practice and exemplary patience; and though comparatively rough analyses for commercial purposes may be made the means of obtaining a good income, no one could get a living by conducting those refined investigations upon which the progress of chemistry chiefly depends. As a rule, discoveries are now made by men who earn their bread by teaching, and spend their savings and occupy their leisure in original research. This is true in all the sciences, and a little investigation will show, that in physics, astronomy, physiology, and comparative anatomy, those things which only required small means have been accomplished, and new discoveries are the result of laboriously employing costly appliances.

Let us consider a few of the present desiderata in astronomy, beginning with the moon. The main interest at present excited with respect to our satellite relates to the question of whether or not changes are now taking place on the lunar surface, and whether the hollows of the side exposed to our view are absolutely airless, or are filled with a low-lying atmosphere of a character not known. No one supposes that in recent times any lunar eruptions have occurred of sufficient magnitude to form craters or walled plains of enormous diameter, like Copernicus, Tycho, Gassendi, or Plato. Those who think they have discovered changes, call our attention to small markings, or to mountains, which are mere specks in ordinary instruments with moderate magnifying powers. Fortunate chances of remarkably clear air, and favourable position, may bring some important fact, not hitherto noticed, within the reach of small instruments, but the main work of investigation must be done with telescopes of great size, thoroughly well mounted in suitable observatories, and supplied with the best micrometers, and other expensive apparatus. The physical peculiarities of Jupiter, Mars, and Saturn demand equal instrumental means, and the nebulæ can only be studied with instruments that cost a little fortune to buy.

There is another thing to be considered besides the costly nature of the appliances of modern research, and that is the necessity for prolonged, and frequently for continuous, observation and record. In meteorological observations, the movements of the wind, the changes in magnetic or electric currents, the variations in temperature, and similar facts, are, to a great extent, recorded by automatic machines, but discoveries in observational astronomy require skilled human agency systematically and unremittingly at work. Our government maintains the Greenwich observatory to make observations of a special character, which may be generally described as having for their object the exact positions and motions of celestial bodies, but that establishment is not intended for, and rarely directed to, original research. The observer who wishes to add to existing knowledge concerning the physical constitution of the moon or planets, or nebulæ, should be always on the watch for favourable opportunities; and if discovery is to be hastened, the following things—all expensive—are required:—well-constructed observatories, in good situations, supplied with the best instruments, and each having a competent director and a staff of qualified observers, so that the work should never stop when the weather would permit it to go on.

Of course, no one would dream of earning the means of sub-

sistence by engaging in labour of this kind, except for guaranteed pay. The finest discoveries would be perfectly unsaleable, and if England wishes to stand as a scientific chief amongst the nations, she must make up her mind to pay for work which may be the means of indirectly adding enormously to her wealth, but which can win no commercial recompense for those who engage in it.

In physics, physiology, etc., continuity of attention becomes daily more requisite for the elucidation of new truths. Desultory and occasional work cannot now do what it did fifty or twenty years ago, because surface facts are to a great extent exhausted, and deep digging is indispensable. There will no doubt be plenty of useful work for amateurs to occupy their leisure hours; but professional students, giving their whole time and thought to their duties, will be the principal instruments for advancing the sciences beyond their present point. It is agreed on all hands that we want a staff of *professional teachers*; but the public have not hitherto had their attention called to the necessity of forming a staff of *professional discoverers*. Yet there is no doubt that they will, when they understand the matter, support the proposition of Colonel Strange, "to found National Institutions expressly for the practical advancement of scientific research, apart from Educational Institutions for workers as distinguished from learners." Private exertions for the advancement of science would be stimulated, and not repressed, by Colonel Strange's plan. His "Colleges of Discovery and Research," or whatever they would be called, could never interfere, except beneficially and helpfully, with private work. As Colonel Strange remarks, "Men engaged in science, but unconnected with the various scientific corporations, need hardly be told that if they discover a new substance, the determination of the physical properties of which is attended with cost and labour, they will experience a great—perhaps insuperable—difficulty in obtaining its examination. A new theory, or the confutation or confirmation of an old one, if dependent on any considerable accumulation of facts, shares even a worse fate. The inquirer may seek in vain for an establishment which could, even if it would, undertake, and complete with accuracy and system, a costly and tedious investigation on which vast interests may be dependent."

The English people pride themselves so much upon their practical character—by which a short-sighted, impracticable disposition is often designated—that they will be unwilling to invest any of the national pounds, shillings, and pence in science, unless science can promise to make a speedy and remunerative pounds, shillings,

and pence return. The average want of knowledge of the community tends to a want of faith in the value of pursuits not obviously connected with mercantile gains. With a higher tone of public feeling to deal with, it would be sufficient to show that the proposed institutions would advance the perception of truth; but the existing John Bull must be convinced that the truth will pay; and for his comfort, in conscience and pocket (if there be a distinction between the two), he may be informed that abstract scientific discoveries nearly always lead to concrete profitable results, and that whereas this process went on slowly in former times, it goes on rapidly now. The "practical man" would have thought little of the philosopher who watched the deflexion of the compass-needle when acted upon by an electric current; and yet upon this observation has been suspended a gigantic business of telegraph-making and telegraph-working. The "practical man" would not have given many of the blood-drops from his till for Davy or Wedgwood's trials at sun picture making; and yet thousands of people now maintain their families by practising, or preparing the materials for, the photographic art. There is nothing more certain than that science does pay a nation, though the nation may rarely and stingily pay its devotees. Government intervention, as contemplated by Colonel Strange, could not do any of the harm that State meddling frequently accomplishes. When a government is invoked to assist in teaching science, there may be some fear lest it should exhibit a preference for erroneous theories or antiquated methods, or set up thirty-nine articles of scientific belief; but the worst it could do, in colleges intended for discovery, would be—not to discover; and that could be remedied by stopping the pay. It is unlikely that such institutions would be so mismanaged as to put forth grossly inaccurate results. Nothing of the kind has occurred at Greenwich, or in the Ordnance Survey; and there would be no difficulty in finding men of high character and accurate knowledge to fill all the responsible posts.

Although not forming any portion of an educational system, the Colleges of Discovery and Research would have a valuable indirect influence upon all good schools, because they would open the doors of remunerative employment to pupils who distinguished themselves as scientific students. At present, a great defect of English society is the impossibility of getting a living by pure science; and no class of men are more entitled to public assistance than those who devote their lives to the discovery of truth.

AUSTRIAN EXPEDITION TO OBSERVE THE ECLIPSE.

TRANSLATED BY W. T. LYNN, B.A., F.R.A.S.

Dr. Weiss of Vienna had charge of this expedition, and selected Aden as his place of observation, chiefly because he had heard much of the usual freedom of the sky there from rain and cloud. The expedition sailed from Trieste on the night of the 18th of July, in the steamer "Austria," and arrived, after a very agreeable voyage, at Alexandria on the morning of the 24th. Next day they proceeded on their journey. After leaving Suez, where they were received by their own consul, Herr Gärtner, they sailed down the Red Sea, suffering the usual inconveniences of its climate, and arrived at Aden on the first day of the following month. I translate the account of their reception there, and of the manner in which they accomplished the object of their journey from the words of Dr. Weiss himself:—*

"On the 1st of August, we awoke in sight of the barren and indescribably rugged and wild rocky coast of Aden, and landed there about nine o'clock in the morning, when we took up our quarters in the "Prince of Wales," the only hotel, which was kept by a Parsee, and near the landing-place. For the characterizing of this house, I need only mention that, on opening the rooms into which we were shown, a number of lizards, which were frolicking about in them, looked inquisitively at the intruders, who had dared to disturb their tranquillity. From these quarters we were, a few hour afterwards, delivered by the governor of Aden, General J. Russell, who invited us to take up our abode at his house, until we should have pitched upon a place suitable for making our observations. He informed us that we were to consider ourselves as the guests of the English government, and that he would do all in his power to facilitate the execution of our scientific mission, and procure us all possible conveniences. He further told us that the English officers had already made a survey of the peninsula, and met with three spots, which appeared to them to be adapted to our purpose. Accordingly, next day we inspected these, and selected one of them called Marshag Hill, an elevation on the east side of the peninsula, with a lighthouse on the top, and about two English miles from Aden. Within two days the governor's pungaloo was set up and put in order for us. (This is a house built in Indian fashion, made only of wood and reeds, so that the wind might pass

* "Astronomische Nachrichten," No. 1716.

as freely as possible through all its rooms.) Three Indians and six negroes of the Somali coast were placed at our service, and a small caravan of dromedaries and asses went daily between Aden and Marshag Hill to provide us with water and other necessaries of living. I must not neglect to express the very warm thankfulness which we all felt to the whole of the English authorities and officers for the friendly assistance afforded us by them in every respect; without this we could not have surmounted the many difficulties which occurred in the transport and setting up of our heavy instruments.

"Well provided, however, as we were at Marshag Hill, we had one great cause of anxiety, viz., the apparently small probability of being able to succeed in actually making the observations. The course of the weather was from day to day, with terrible uniformity, the following: the sky, previously clouded, towards nine o'clock in the morning cleared up, and continued quite bright until about an hour after sunset. Then small feathery clouds began to show themselves, which gradually developed into cirrus and cirro-stratus, and covered the whole heavens, becoming continually denser and denser until sunrise, after which they again disappeared. On the day of the eclipse, the sky, when we arose, was almost completely clouded, and particularly in the east, thick banks of cloud hung upon the horizon. We made preparations for the observations without much hope, but took courage somewhat when, towards six o'clock in the morning, some gaps appeared in the clouds near the sun. And indeed in one of these, ten minutes before the beginning of totality, we caught sight, for some moments, of the sun's crescent, already very narrow; but not until five minutes before the long expected moment of totality did it pass into a perfectly clear part of the sky. There it continued throughout the whole duration of totality, enabling us to carry out all the observations which we had planned. . . . .

"During this eclipse, there were seen, besides the narrow bright red border which always for a few minutes before the beginning and end of the totality wreathes the dark edge of the moon with its long radiations, on both sides of those points where the last ray of the sun disappears, and the first again breaks forth, three other larger prominences also. The most remarkable of these was a sharply-defined, finger-shaped one, brilliant with the most vivid carmine red, the length of which amounted to about the eighth part of the sun's semidiameter. It not only remained visible during the whole time of totality, but was not withdrawn from sight by passing clouds until after the termination. Dr. Theodore Oppolzer and I

both made measures of the position and magnitude of each of these protuberances, and we agreed very well with each other. I also directed my attention to the corona, which had a certain general similarity to that seen in Spain, at the solar eclipse of 1860, July 18th. It could not, however, be so well observed as I wished, because its longer radiations were for the most part concealed by clouds.

"The spectral investigations were made by Lieutenant Rziha, who remarked, at the occurrence of the totality, a sudden disappearance of all the dark (Fraunhofer's) lines, the spectrum passing into a so-called continuous one, faint indeed, but still quite distinctly visible. Towards the end of the totality, when a thin veil of cloud had passed over the sun, by which the corona was hidden, whilst the protuberances glimmered through it, the most refrangible part of the spectrum disappeared almost entirely, and there remained only a series of red bands, separated from each other by broad dark spaces. . . .

"Shortly after the end of the eclipse, we heard with pleasure that the labours of our North-German colleagues (who had set up their photographic apparatus at a few hundred yards' distance from us), had also been crowned with the best success, they having succeeded in obtaining several very excellent records during the totality. On joyfully sitting down all together to a common meal, we merrily held up our glasses to congratulate each other on our unexpected success, not forgetting also our dear far-off friends at home, whose thoughts would that day, we well knew, be rambling after us.

"A few days afterwards, we left the peninsula of Aden in the English steamer "Carnatic," and watched, not without some emotion, the coasts of that land gradually fade away from sight, the inhabitants of which had received us during our short sojourn, with so much courtesy and kindness, and where the sky had, at the critical moment of the eclipse, favoured us with the opportunity of making the observations."

THE CONNECTION OF INFUSORIA WITH DISEASE.

BY M. J. LEMAIRE.

In "Comptes Rendus," 28th September, 1868, is an abstract of a paper by M. J. Lemaire, entitled "Typhus, Cholera, Plague, Yellow Fevers, Dysentery, Intermittent Fevers, and Hospital Gangrene: are they due to Infusoria acting on Ferments?" which we translate, as it may suggest interesting inquiries which our microscopic readers may follow up.

M. Lemaire commences by inquiring whether the maladies just enumerated are distinct species? He says: "The names which have been given to them are based upon their chief symptoms. They seem without scientific value, because we may find in one of these complaints the symptoms of all the others united, and, moreover, they may be produced by very different causes. It is sufficient to consult the synonyms of these maladies to show that a great many authors have not accepted their various appellations. In the midst of the confusion of names, and of opinions to which they have given birth, we find the landmarks set up by the princes of medicine, who traced a path which seems to tend to a demonstration of the specific unity of these maladies.

Physicians since Hippocrates, and the veterinarians, have established the fact, that wherever matter in putrefaction exists in abundance, serious maladies, transmissible according to some, intransmissible according to others, have their birth. The maladies with which I am now concerned are endemic in the vicinity of large collections of matter in putrefaction.

My researches into the nature of the miasmata supplied by the human body in a state of health, and which are able to engender typhus and hospital gangrene, demonstrate that they also arise from matter in putrefaction. Thus there exists for all these disorders one common cause—materials in putrefaction.

When we analyze with care the symptoms observed in these disorders, we find that this common cause produces common effects, and identical anatomical lesions. For example, buboes, authrax, moist gangrene, petechia, gastro-intestinal symptoms, and others, which are observed in individuals attacked with the plague, exist in hospital typhus, in severe typhoid fever, yellow fever, and the dysentery of hot countries. I may add, that the princes of medicine, recognizing to a great extent the parentage of these maladies,

have confounded under the generic name of plague, pestilential fevers, malignant, putrid, and typhus. From these, and other facts which I might adduce, the great importance of the comparison I have just made will be apprehended. Still, if I call to mind the medical axiom, that certain symptoms may vary the species, but not change it, I am led to establish the identity of these maladies, which I hope will before long be arranged under the class of parasitical diseases.

Solid or liquid aliment, in putrefaction, introduced into the digestive tube of a man or an animal in health, determines the symptoms which we observe in these disorders. Numerous and varied experiments made on animals in health, with substances in putrefaction (emanations, innoculations, injection into the veins or digestive tube) have given the same results—grave symptoms, or death.

Since I demonstrated that the gas and vapour arising from matters in fermentation carry with them a considerable quantity of spores and reproductive bodies of microzoaries, these results are easily explicable, since by the respiratory passages, as well as by the way just indicated, infusoria may penetrate the organism, either in the germ form, or when fully developed.

It cannot be doubted that bacteria and vibrions exist in the blood circulating in typhoid and small-pox patients, and in those afflicted with splenic disease, anthrax, moist gangrene, or malignant pustule. These same animalcules,* and even monads and cercomonads, exist in typhus, choleraic and dysenteric dejections. Eminent microscopists have seen them as well as myself.

These facts are of the highest importance, as I shall proceed to show not only that these organisms do not exist in a normal state, but that it kills them.

I made experiments upon myself in a state of health, with a view to see if a diet exclusively vegetable or animal exercised any influence over the appearance of these infusoria in the fœces. These experiments, which gave negative results, have acquired a veritable importance. Having been attacked, some months afterwards, by a violent fit of cholera, I made a fresh study of these matters, eight days after the beginning of the disorder. I found at the moment the dejections were expelled, they contained myriads of bacteria and vibrions, *linea*, *rugula*, and chained. There were also *Spirillum volutans*, monads and *Cercomonas crassicauda*. This observation, compared with the preceding, is very important, and became still more

* They are probably vegetable.—Ed.

so by a third which I made. Two months after the commencement of my illness, being completely re-established, I examined my dejections with a microscope, and found no infusoria. Thus their presence was due to cholera.

Having perspired abundantly, I found in the matters collected from various parts of the skin, spores analogous to those described in my Memoir on Miasmas, and a considerable quantity of bacterium and little vibrions. Obliged to neglect my mouth for some time, I found in it abundance of bacteriums, vibrions, spirillum, and monads. I caused a flannel waistcoat, I had worn for some days, to be washed, as soon as it was taken off, in a small quantity of distilled water. Examining this liquid under the microscope, I found the same species of microphytes and microzoaries, as I had found in the skin.

This is not all. Blood taken, during life, from man or an animal afflicted with typhus, or small-pox, containing bacteria and vibrions, has been innoculated or injected into the veins of dogs, sheep, and rabbits in a healthy state. Bacteriums and vibrions have multiplied in those creatures, producing formidable symptoms, and almost always death. Comparative experiments made by M.M. Caze and Feltz with blood taken from a healthy man, prove that under these circumstances, there is no elevation of temperature or disease.

If we kill the infusoria in putrifying matters, as I have long done with various substances, not only do we abruptly arrest the fermentation, but we, at the same time, prevent the communication of diseases by emanation, innoculation, or contact. After the death of the infusoria the matters are harmless.

In my book on phenic acid will be found important applications of these results to therapeutics.

ASTRONOMICAL NOTES FOR NOVEMBER.

BY W. T. LYNN, B.A., F.R.A.S.

Of the Royal Observatory, Greenwich.

MERCURY will be at his greatest elongation on the 21st day, and will, therefore, be visible to the naked eye in the latter half of the month before sunrise. On the 23rd (when he rises about twenty minutes before 6 A.M.), he will be very near the second-magnitude star, *α* Libræ. A transit of the planet over the Sun's disc will occur on the 5th, but as it will be nearly half over at sunrise (which takes place at 7h. 3m.), circumstances will not be favourable for its observation. The passing off the disc, however, at a few minutes past nine, may be seen if the sky be cloudless near the Sun. The appearance of the planet during the part of the passages just previous, as a small well-defined dark spot, will be very interesting.

VENUS will still be conspicuous in the early morning, rising, on the 1st day, at 2h. 47m., and, on the last, at 4h. 6m. But, as she is approaching superior conjunction, her apparent brilliancy is diminishing.

MARS rises now somewhat earlier, but not until past ten o'clock at night, even at the end of the month. In December he will be more favourably situated for evening observation.

JUPITER will continue to be a brilliant object until considerably past midnight. He will be on the meridian at nine o'clock on the 10th, and at eight o'clock on the 25th.

PHENOMENA OF JUPITER'S SATELLITES.—The following table contains all those phenomena which occur before midnight, and whilst Jupiter is sufficiently high in the heavens after dark to admit of their being readily observed. The disappearances of the first and second satellite at eclipse will not be visible, as they take place behind the planet as seen from the Earth. But at emergence from the planet's shadow, the first satellite will reappear at the distance of about half a diameter, and the second of nearly a whole diameter, of Jupiter, to the right of him, as seen in an inverting telescope. The third satellite may be observed, at eclipse, both to disappear and reappear: the former about half a diameter's distance from the planet, the latter about a whole diameter. The fourth satellite will this month neither suffer eclipse, nor pass either in front of, or behind, the planet.

DATE.	SATELLITE.	PHENOMENON.	MEAN TIME. h. m.
November 1 ...	I.........	Occultation, disappearance ...	10 36
„ 2 ...	II.........	Transit, ingress	6 56
„ 2 ...	I.........	Transit, ingress	7 50
„ 2 ...	II.........	Transit, egress	9 25
„ 2 ...	I.........	Transit, egress	10 4
„ 3 ...	I.........	Eclipse, reappearance	8 3
„ 4 ...	II.........	Eclipse, reappearance	5 32
„ 4 ...	III.........	Eclipse, reappearance	5 56
„ 9 ...	II.........	Transit, ingress	9 17
„ 9 ...	I.........	Transit, ingress	9 36
„ 9 ...	II.........	Transit, egress	11 48
„ 9 ...	I.........	Transit, egress	11 51
„ 10 ...	I.........	Occultation, disappearance ...	6 50
„ 10 ...	I.........	Eclipse, reappearance	9 59
„ 11 ...	III.........	Occultation, reappearance ...	6 13
„ 11 ...	I.........	Transit, egress	6 18
„ 11 ...	III.........	Eclipse, disappearance	7 24
„ 11 ...	II.........	Eclipse, reappearance	8 8
„ 11 ...	III.........	Eclipse, reappearance	9 57
„ 16 ...	I.........	Transit, ingress	11 24
„ 16 ...	II.........	Transit, ingress	11 41
„ 17 ...	I.........	Occultation, disappearance ...	8 39
„ 17 ...	I.........	Eclipse, reappearance	11 55
„ 18 ...	I.........	Transit, ingress	5 51
„ 18 ...	II.........	Occultation, disappearance ...	6 10
„ 18 ...	III.........	Occultation, disappearance ...	6 57
„ 18 ...	I.........	Transit, egress	8 6
„ 18 ...	III.........	Occultation, reappearance ...	9 48
„ 18 ...	II.........	Eclipse, reappearance	10 44
„ 18 ...	III.........	Eclipse, disappearance	11 27
„ 19 ...	I.........	Eclipse, reappearance	6 24
„ 24 ...	I.........	Occultation, disappearance ...	10 29
„ 25 ...	I.........	Transit, ingress	7 41
„ 25 ...	II.........	Occultation, disappearance ...	8 34
„ 25 ...	I.........	Transit, egress	9 56
„ 25 ...	III.........	Occultation, disappearance ...	10 35
„ 26 ...	I.........	Occultation, disappearance ...	4 57
„ 26 ...	I.........	Eclipse, reappearance	8 20
„ 27 ...	II.........	Transit, egress	5 55

Occultations of Stars by the Moon.—We give a list of eight of these phenomena, which occur either before midnight, or within a short time after it, extending the limit on the 29th, in order to include the occultation of Aldebaran, which will be extremely interesting if the state of the sky permit of its being observed. The passage of the Moon through Taurus will make that night of great importance to the astronomer. It should be mentioned that whilst θ^1 Tauri is occulted, θ^2 Tauri, a star of equal magnitude, and very near it, will just escape occultation.

DATE.	STAR.	MAG.	DISAPPEARANCE.		REAPPEARANCE.	
			MEAN TIME.	V.	MEAN TIME.	V.
			h. m.	°	h. m.	°
Nov. 27	μ Ceti	4	11 15	106	12 26	337
" 28	f Tauri	4	7 10	34	8 1	299
" 29	γ Tauri	4	4 29	66	5 21	249
" 29	75 Tauri	6	8 32	99	9 33	232
" 29	θ^1 Tauri	4½	8 46	353	8 58	334
" 29	Bradley, No.619	5	9 33	37	10 28	308
" 29	Aldebaran	1	12 41	72	13 36	349
" 30	119 Tauri	5½	11 27	103	12 36	254

New Planets.—Professor C. H. F. Peters, of Hamilton College, Clinton, New York, discovered No. 102 of the group of minor planets on the 22nd of August last. Professor Watson, of Ann Arbor, Michigan, discovered three more in September: No. 103 on the 7th, 104 on the 13th, and 105 on the 16th. No. 100 has received the name of Hecate, and 101 of Helena; the later ones are as yet unnamed.

The Moon.—New Moon takes place at five minutes before eleven on the morning of the 14th, so that observations of the regions under the terminator may commence about the 17th. First Quarter is at 6h. 46m. a.m. on the 22nd, and Full Moon at one o'clock on the morning of the 30th. We have not space this month to enter into any detail on lunar objects.

The November Meteors.—The orbit of the remarkable group of meteors which appear this month may now be considered as established with tolerable certainty. To Professor H. A. Newton, of the United States, belongs the merit of having laboriously collected and

discussed all the extant original accounts of their appearance,* from the year 902, when they were observed (as related by Condé) on the night of the 12th of October (on which the Moorish king, Ibrahim Ben Ahmed, died), to 1833, when the brilliant display seen on the coast of America, on the 13th of November, drew general attention to the subject. From the data thus obtained, he inferred that they recurred in cycles of 33¼ years, and the conclusion was subsequently confirmed by the grand spectacle exhibited on the night of 1866, November 13, which was witnessed by multitudes of observers, both scientific and unscientific, and which no one who saw it can ever forget. It was after this that the examination of the question, whether it was possible to determine satisfactorily, according to the principles of physical astronomy, an orbit for the group round the Sun similar to those described by the periodical comets was undertaken by Professor Adams.† His labours were crowned with success, and led to very interesting results. Newton had found, from his historical researches, that the shower took place continually later and later, those of 1002, 1101, 1202, 1366, 1533, 1602, 1698, and 1799, being observed on October 14, 17, 19, 23, 25, 27, November 9 and 12, respectively. Hence it followed that the earth's longitude at the time of the appearance, or the longitude of the node of the orbit of the meteors, was gradually increasing. The amount of this increase was about 52″ each year. Now, Professor Adams found, by assuming a period for the meteors of 33¼ years, the perturbing action of the large planets would really produce an increase in the longitude of the node of about 28′ each revolution, which, divided by 33·25, gives 50″, almost exactly the observed quantity. His own comment upon this was, that he could not help thinking that it "settled the question as to the periodic time of these bodies beyond a doubt." According to his calculations, the mean distance of the meteors from the sun is 10·34 that of the Earth, the eccentricity of their orbit being 0·905, and the Earth encountering them when they are in perihelion, both being then about the same distance from the Sun. Now we must pass near this point every year; but it would seem that, although the entire circumference of the orbit, or nearly so, contains meteors, there is one part, the length of which is rather uncertain, but may, perhaps, be about one-twentieth of the whole, where they are crowded together in much larger size and quantity than in any other part. The consequence is, that about every thirty-three years we see

* "American Journal of Science and Arts," Nos. 111 and 112.

† "Monthly Notices of the R. A. S.," vol. xxvii., p. 247.

a very brilliant display, which is sometimes repeated on the year following. We need not here again dwell upon the fact, which has already been sufficiently brought before our readers, that, following the remark of Schiaparelli in the case of the August meteors, a close similarity, and almost identity, was at once perceived between the orbit of the November meteors and a comet discovered by Tempel, and known as Comet I., 1866. The elements of that body, as determined by Oppolzer, gave a period of 33·18 years, the mean distance being 10·325, and the eccentricity 0·905.

We must remark, that as this year we shall pass through the orbit of the meteors about noon (Greenwich time) on the 13th of November, we can scarcely expect to see any of those belonging to the group in this country at all. Next year we may, indeed, see some in the early evening, but, of course, a grand display cannot be looked for again until about the end of the century. It seems, however, that meteors also belonging to other groups are seen about the same time; and Professor Heis, of Münster, whose exertions in this department of science are so well known, tells us,* that of 261 shooting-stars which were observed and mapped down either by himself or at his instance, in different parts of Germany, on the 12th, 13th, or 14th of November last year, 69 belonged to the radiant-point in the constellation Leo, whilst 37, 21, 15, and 5 belonged to other radiants in Perseus, Cassiopeia, Taurus, and Draco, respectively. Out of all these, four only were so well observed simultaneously, at two stations, as to furnish the means of calculating their actual paths and heights. But in the August epoch of the same year a much larger number of shooting-stars was observed, amounting in all to 809, on the nights from the 8th to the 12th, besides a considerable number on the 28th of July, which is also a time when they are very frequent. On discussing the whole of these, eleven were found to have been coincidently observed at two stations, besides a very remarkable one which was seen at 9 o'clock on the evening of the 19th of August, at places very considerably distant from each other. It was stated to be three times as bright as Jupiter, and was computed to be 94·5 English miles high when first seen, and 29·2 miles at its disappearance.

THE GREAT SOLAR ECLIPSE.—We are now in possession of written accounts of the observations of the great Solar Eclipse of last August, made by Major Tennant and Lieutenant Herschel. Our readers have, doubtless, already seen parts of these, which have been communicated to the papers. The general result obtained

* "Astronomische Nachrichten," No. 1707.

appears to be that the corona or atmosphere surrounding the Sun, becomes visible during an eclipse from its power of reflecting the light of the Sun, being entirely or almost entirely destitute of luminosity of its own, and that, on the other hand, the rose-coloured protuberances or prominences (the latter designation is now usually preferred) do really consist of gaseous matter in a condition of ignition or luminosity. The definitive settlement of these questions will for ever render the eclipse of 1868, August 18th, memorable in the history of astronomy, and has amply repaid the labour and expense employed in the expeditions sent to Hindostan for its observation. In all future attempts to theorize upon the constitution of "the bright and orbed blaze," these facts will have to be kept prominently in mind, and, assisted by the growth of her recently-adopted sister, chemistry, astronomy will gradually lead us to more correct ideas concerning the nature of the action of the great central body of our system upon the economy of its other members, and the living organisms which tenant certainly one, and probably, at least, several more. Upon this subject, however, we do not propose, at present, to offer any remarks, though we may avail ourselves of a future opportunity of doing so; but as we wish THE STUDENT to contain a record of all that is most interesting in the progressive history of astronomy, it is desirable to give here quotations from the letters of our English observers of the eclipse; the accounts of the foreign observers are not yet received in fulness.*

Major Tennant, writing to the Astronomer Royal, on the day of the great event, whilst at Guntoor, stated that the clouding over of the eastern sky with thin cumulo-strati, made his attempts to obtain photographic records almost failures. In other respects, however, and more important ones, he was more successful. His coadjutor, Captain Branfill, found the protuberances unpolarized, and the corona strongly polarized everywhere in a plane passing through the centre of the Sun. Major Tennant himself found a continuous spectrum from the corona, and one of bright lines from a prominence which he examined, the positions of three of which lines he determined. "I conclude," he says, "that my result is that the atmosphere of the Sun is mainly of non-luminous (or faintly luminous) gas, at a short distance from the limb of the Sun. It may have had faintly luminous lines, but I had to open the jaws a good deal to get what I could see at first, and consequently the lines would be diffused somewhat, still I think I should have seen them. The

* In another part of this number a translation will be found of Dr. Weiss's account of the Austrian expedition, which has been received since the above was written.

prominence I examined was a very high, narrow one, almost to my eye like a bit of the sun through a chink in brightness and colour (I could see no tinge of colour), and somewhat zig-zagged like a flash of lightning. It must have been three minutes high, for it was on the preceding side of the sun near the vertex, and was a marked object, both in the last photo-plate, just before the Sun reappeared, and to the eye."

Lieutenant Herschel was entrusted with the instruments belonging to the Royal Society, and, confining his own attention to the use of the spectroscope, saw also, on applying it to one of the prominences, a discontinuous spectrum, with three vivid lines in the parts corresponding to red, orange, and blue. "The corona," he says,* "may have projected a spectrum of some kind, but I saw none. I thefore conclude it was a faint solar spectrum, a conclusion in accordance with other characteristics of the phenomenon, but especially with the (flickering?) radiating appearance, and with the satisfactory determination by Lieutenant W. M. Campbell, R. E., of the conditions of polarization obtaining in the corona. At present, it is sufficient to state that these observations leave no doubt that the light of the corona is polarized in planes passing through the sun's centre."

Distance of the Sun.—The reproach is at last wiped away from astronomical observation, and the sneers indulged in by non-scientific persons,† as to its having yielded a result affected by an error of so large an amount as four millions of miles in the fundamental measure of the solar system, the Sun's distance, shown to be utterly misplaced. In the time of Sir Isaac Newton great uncertainty was known to attach to the measures hitherto attempted of that distance upon which the knowledge of all other distances in the system depended; and all that could be said to be known was, that it probably exceeded eighty millions of miles. To Dr. Halley, the second Astronomer Royal, the remark was due, that the transits of Venus over the sun's disc, which sometimes take place at her inferior conjunctions, furnish, from the peculiar relative positions of the Sun, planet, and Earth, opportunities for determining their absolute distances much more accurately than is attainable by any other means; and that, in fact, there was reason to hope that the Sun's

* Letter to Mr. Huggins, F.R.S., dated Belgaum, 1868, August 25th.

† We were extremely sorry lately to find a very eminent man in another walk of science taking part in such reflections, which we believe to have been not quite just, even on other grounds than those mentioned in the text. Of course, we allude to Dr. Hooker, in his opening speech at the late meeting of the British Association.

distance from us might in this way be ascertained within an error of about a five hundredth part of the whole. The phenomenon is one, however, unfortunately of very rare occurrence, and even when it does occur, it is not always under the most favourable circumstances for the necessary condition of its observation at two stations considerably distant from each other. A transit, which took place in 1761, was observed by several astronomers, and the more favourable one of 1769 was observed at a great number of places—the celebrated expedition of Captain Cook to Otaheite being, as is well known, the only one of those sent to the southern hemisphere that was successful. There, however, it was well observed at a place called, in consequence, Venus Cape. The observations in the northern hemisphere were numerous, and several of them good. The result which was deduced by the late Professor Encke from his discussion of all the observations, was long considered to be satisfactory and decisive. Till quite lately, indeed, there was no cause to suspect it of being erroneous in any considerable proportion. We need hardly say that that result was, that the Sun's horizontal parallax was $8''\cdot5776$, and his distance, what we have all been taught in our childhood, about 95,000,000 of miles. About ten years ago it appeared, from the investigations of great physical astronomers of our time, that this parallax was probably somewhat too small, and the resulting distance somewhat too large. It was pointed out by the present Astronomer Royal, and others, that some of the oppositions of Mars afford a means of determining the sun's distance, not, indeed, quite so favourable as a transit of Venus, but in many respects extremely well adapted to the purposes, and of more frequent occurrence. One of the most suitable of these took place in the year 1862, and a great number of excellent observations was made both in Europe and North America, and also at the Cape of Good Hope, and in Australia. The result was that the sun's horizontal parallax was about $8''\cdot94$, and his distance about 91,430,000 miles. Although it was felt that great reliance could be placed upon this, embarrassment was felt at the difficulty of explaining how it differed so much from the result given by the transit of Venus.

Astronomers were hard pressed at having found such discordant results, and doubt was, not unnaturally, cast upon the new and improved determination. Although the general public could not deny there was much force in the remark made by the late president of the Royal Astronomical Society (the Rev. C. Pritchard) that the error supposed to be committed in the measurement of the parallactic angle was equivalent to the angular measure of a *human hair* at the

distance of 125 feet, or a sovereign at the distance of *eight miles*, yet the uneasy feeling was not entirely removed, and astronomers themselves felt that the transit of Venus ought to have furnished a more accurate result. Herr Powalky cut the Gordian knot by obtaining, by a different treatment of the observations in 1769, a result agreeing, pretty nearly, with that recently obtained from the opposition of Mars; but as it appeared that he had too freely used the process of arbitrary selection and attribution of weights, astronomers refused to allow that the difficulty was thus removed. And other persons would do well to notice how severely determined men of science are to accept only results which are known to be free from all bias in the methods by which they are arrived at.

Mr. Stone, First-assistant at the Royal Observatory, Greenwich, has quite recently turned his attention to this subject, and has rediscussed the whole of the observations of the transit of Venus. He has found that previous calculators, including Encke, have fallen into a fundamental misunderstanding of some expressions, as to the particular phase or kind of phenomenon* which was observed at some of the stations. He has also found that when this is taken into account, and only those observations are compared together which are really comparable, the result is that the sun's horizontal parallax is 8″·91, very closely agreeing with that derived from the observations of Mars in 1862. We shall probably on a future occasion give some of the details of this interesting conclusion. At present we will only remark that, as the mean distance of the sun deducible from this is about 91,740,000 miles, and that which has been deduced from the opposition of Mars, is, as already mentioned, 91,430,000, it can scarcely now be doubted that the distance, 91,500,000, is really accurate within about 200,000 miles. In such a distance we can hardly expect greater accuracy; yet even such may perhaps be obtained at the transit of Venus in 1882, which will be much more favourable for the purpose than the next future one, which occurs in 1874.

* In consequence of the effects of irradiation of the sun's light as the planet passes on and off his disc, the phenomenon is of a somewhat complicated kind, and the observers made use of different terms in describing it. Mr. Stone has clearly shown that some of these have been misinterpreted. When rightly understood, all the observations are very accordant with each other.

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

Lat. 51° 28′ 6″. Long. 0° 18′ 47″ W.

BY. G. M. WHIPPLE.

(By Permission of the Meteorological Committee.)

(*With a Plate.*)

July, 1868.

Atmospheric Pressure.—During the greater part of the month the barometer remained comparatively steady; and it was not until the 22nd, that any considerable movement was observed.

The mean height on the 1st was 30·246 ins.; at 10 P.M., a fall commenced, and continued until 4 A.M. on the 3rd, bringing the mean down to 29·980 ins. for that day.

On the 8th, there were several minor fluctuations registered. The barometer steadily fell from 8 A.M. to 5 P.M. on the 11th, fluctuated considerably from 11.30 P.M. to 1.30 A.M. of the 12th, continued disturbed throughout the day, oscillating to a great extent from 10 P.M. to 4 A.M. of the 13th, and, after rising a little until 10 P.M., gradually fell until 6 P.M. of the 15th.

The mean reading for the 15th was 29·904 ins. The period succeeding, until the 22nd, was unmarked by any particular barometric changes, the general tendency of the readings being upwards. On the 23rd, the barometer rose slowly until 6 P.M., when the movement became more rapid, and continued so until the maximum height of the month was attained, at 10 P.M. on the 24th, the mean for that day being 30·373 ins. There was an uniform descent until 4 P.M. on the 26th, and the pressure remained constant during the 27th. The lowest reading in the month was recorded on the 28th, the mean for the day being 29·674 ins.

The barometer continued low until 4 P.M. on the 29th, then rose rapidly until noon of the 30th. At 3 A.M. of the 31st, there was a farther upward movement, lasting until midnight, which brought the daily mean to 30·155 ins.

The mean height for the month of July was 30·029 ins.

Temperature of the Air.—The variations of temperature during July were somewhat large.

The means increased from 57·0° on the 1st, to 63·8° on the 3rd. On the latter day, the thermometer was observed to fall from 6 to 8.15 P.M. with unusual rapidity, and then remain stationary until 6 A.M. the next day.

After the 4th, the means increased to 67·9° on the 8th. At 8d., 2 A.M., the record shows the thermometer to have suddenly fallen 3°, then to have recovered its former position, and again fallen. A sudden upward movement was registered at 3.15 P.M. on the 5th; the mercury remained steady at this point until 5.40 P.M., when it fell rapidly 5°.

During the passage of a thunderstorm on the 11th, the temperature was lowered 7°, from 11.30 P.M. to 1.0 A.M.; and again on the 12th, from 10 A.M. to noon, so reducing that day's mean to 59·0°.

On the 15th, there was a depression of 6° in the thermometric curve, from 1.30 to 2.10 P.M.

The 22nd was the hottest day in the year, the mean being 77·8°. The means for the two succeeding days were much lower, 62·8° and 60·8°; they afterwards increased to 71·5° on the 27th.

On the 28th, at 1.45 A.M., a sudden fall of 6° was recorded. The mean on the 29th was only 57·0°, but from this it rose to 66·3° on the 31st.

The highest maximum temperatures registered were 89·2° on the 21st, and 90·2° on the 22nd; and the lowest 65·8° on the 4th and 62·5° on the 29th.

The lowest minima were 49·7° on the 5th and 6th, and 49·9° on the 30th; the highest, 62·5° on the 17th, and 63·8° on the 31st.

The greatest daily range was 31·5° on the 20th; the least, 8·5° on the 29th; and the mean, 22·4°.

The mean temperature for the month was 65·9°.

Relative Humidity.—The days when the amount of aqueous vapour present in the air was least, were the 20th, 0·45, the 22nd, 0·48, and 30th, 0·47 (complete saturation being 1·0); the days of greatest moisture were the 12th, 0·88, and 29th, 0·83; the mean being 0·61.

Rainfall.—The amounts measured were:

1st	0·035 ins.	27th	0·010 ins.
12th	1·034 "	29th	0·170 "
13th	0·400 "	30th	0·010 "

Total fall during the month = 1·659 ins.

Wind.—The general direction of the wind was:—

North—31st.

North-East—1st, 2nd, 3rd, 4th, 6th, 11th, 12th, 13th, 14th, and 23rd.

East—9th, 10th, 14th, 25th, and 26th.

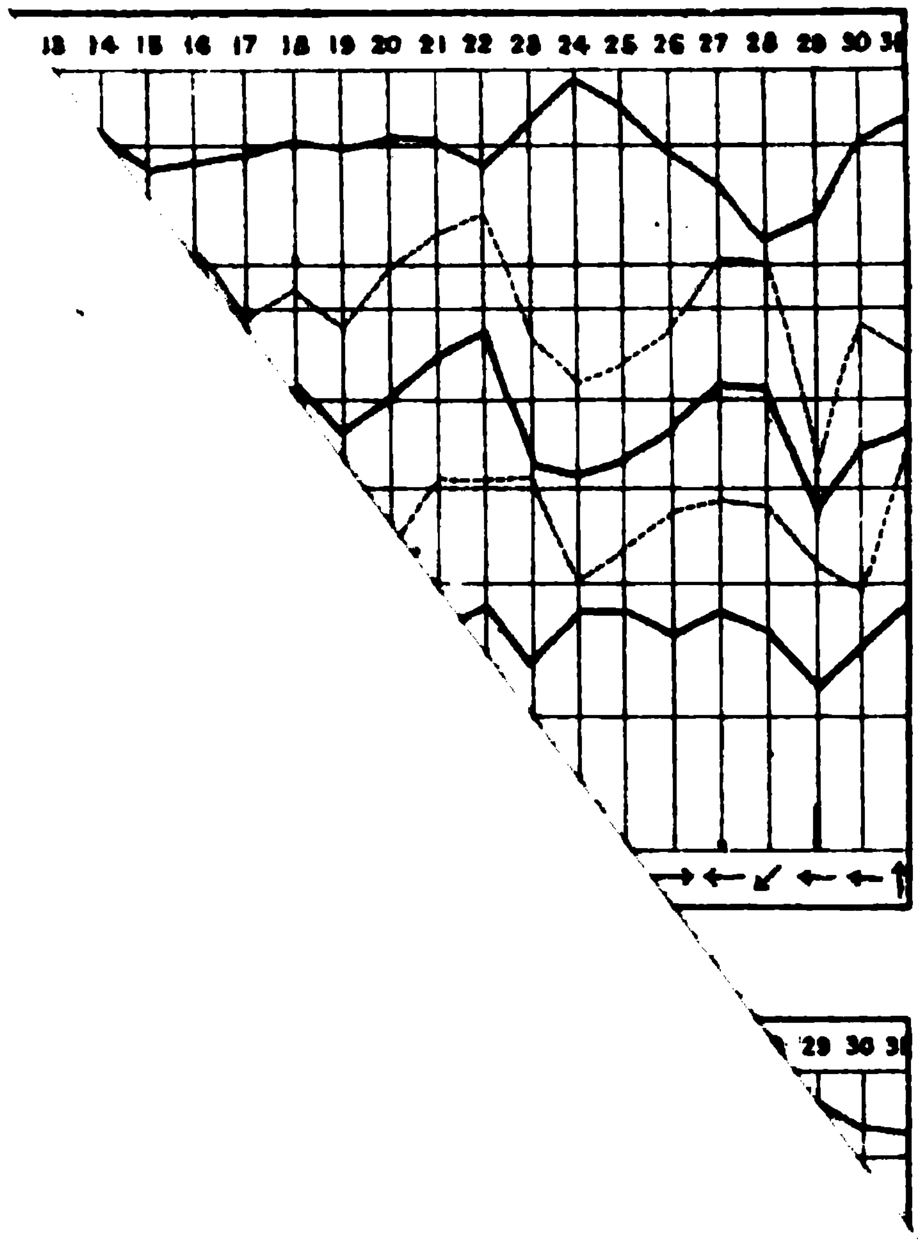
South-East—15th.

South-West—18th, 21st, 22nd, and 28th.

THE METEOROLOGICAL VARIATIONS,

E KEW OBSERVATORY.

, 1868.



West—8th, 16th, 20th, 27th, 29th, and 30th.

North-West—7th, 17th, and 19th.

During the first four days in the month, the wind blew uniformly from the North-East, with a velocity of about twenty miles per hour; but at midnight on the 4th, it veered to North-West, and the rate dimished to five miles. On the 6th, the direction returned to North-East, but the velocity continued low.

At 6 P.M. on the 15th, the wind declined from fifteen miles to three, and the direction veered from South-East to West.

During the night of the 17th, there was a gradual change in the direction, from North-West through North-East and South to South-West, where it remained all the 18th, but went back to North-West in the course of the night. The wind blew at the rate of twenty-five to thirty miles per hour, from the North-East and East, through the 23rd and 24th, but became very light in the night of the 26th, and veered from the East through North to West.

The only perfect calm recorded in the month was from 9.15 P.M. on the 29th to 1.5 the next morning.

August, 1868.

Atmospheric Pressure.—The variations in the readings of the barometer were more numerous, and extended over a greater range in August than in the preceding month.

The mean reading on the 1st was 30·244 ins. From 10 A.M. on the 1st to 6 A.M. the 4th, the barometer went down slowly to 29·873 ins.; it continued falling until 10 A.M. on the 6th, and remained stationary at 29·716 ins.

From 6 A.M. on the 7th it rose, and read 30·138 ins. on the 9th. The mercurial column oscillated some time during the next night, and then began to fall; after the minimum was reached, at 8 A.M. on the 11th, its behaviour became very peculiar; between 9 and 10.50 A.M. it rose 0·122 inches rapidly, then descended 0·049 ins. At this point it remained a quarter of an hour, then fell quickly 0·073, and at 11.20 rose suddenly 0·034 ins., at which point it oscillated slightly until 8 P.M.

The readings gradually increased to midnight, and the mean for the day was 29·571 ins.

At 9.5 A.M. on the 13th the barometric curve recorded a sudden rise of 0·25 ins. On the 15th the barometer rose gradually to 29·863 ins. There were several large fluctuations registered on the 16th, and also from 6 to 8 P.M. on the 17th.

From 29·588 ins., on the 18th, the readings increased to 29·965 ins.

on the 20th; at this point they remained stationary. On the 21st, at 10 P.M., the barometer commenced falling very rapidly, and having arrived at the minimum of the month, rose until noon on the 23rd. The mean for the 22nd was 29·249 ins. The upward movement continued, bringing the mean to 30·111 ins. on the 26th. After falling to 30·004 ins. on the 27th, the barometer rose until the 29th. The two following days it read lower, and was 30,098 ins. on the 31st.

The mean height of the barometer for August was 29,877 ins.

TEMPERATURE OF THE AIR.—The mean temperature gradually increased at the beginning of the month from 63·2° on the 1st to 73·1° on the 4th, but it diminished to 66·5° on the 6th.

From 6 P.M. on that day the thermometer was almost stationary until 8 A.M. on the 7th. The temperature decreased from the 10th to the 13th. During the 13th there was great fluctuation of the thermometer; it rose rapidly from 6 to 8 A.M., slowly from 8 to 9.10 A.M., and then fell quickly until 10 A.M.; afterward remaining constant until 4.30 P.M. The curves for the 14th and 15th, also, show numerous variations of temperature, while those for the 16th, 17th, and 18th were characterized by an almost perfect absence of the ordinary daily oscillations, and on the 21st the daily range was only 5·1°.

On the 23rd the thermometer rose gradually through the day, until 5 P.M., then descended rapidly until 6 P.M. The 27th had a higher mean temperature than the previous days, which was 61·3°.

The highest maximum temperatures recorded were 84·5° on the 4th, and 85·4° on the 5th; the lowest, 66·6° on the 18th, and 62·0° on the 20th.

The lowest minima were 47·7° on the 1st, 45·7° on the 26th, and 47·3° on the 28th; the highest, 64·6° on the 7th, and 63·0° on the 11th.

The greatest daily range was 32·8° on the 1st; the least 5·1° on the 20th; and the mean 16·8°.

The mean temperature for the month of August was 62·7°.

RELATIVE HUMIDITY.—The days when there was least moisture in the air were the 2nd and 4th, the proportion being 0·47 on each of these dates. There was most humidity on the 13th and 17th, which were 0·96 and 0·95.

The mean for the month being 0·73.

RAINFALL.—The quantities of rain measured were as follows:—

DAY.	AMOUNT.	DAY.	AMOUNT.	DAY.	AMOUNT.
6......	0·210 inch.	14......	0·269 inch.	22......	0·384 inch.
7......	0·160 „	17......	0·220 „	23......	0·052 „
8......	0·005 „	18......	0·645 „	24......	0·023 „
12......	0·098 „	19......	0·328 „	27......	0·020
13......	0·021 „	20......	0·135 „		

The total fall during the month being 2·520 ins.

WIND.—The general direction of the wind was:—

North—20th.

North-East—16th and 17th.

East—18th.

South-East—2nd, 3rd, 4th, and 10th.

South—5th, 14th, and 15th.

South-West—1st, 6th, 9th, 11th, 12th, 13th, 22nd, and 26th.

West—7th, 8th, 21st, 24th, 27th, 28th, 30th, and 31st.

North-West—23rd, 25th, and 29th.

At 6.50 A.M. of the 2nd the wind veered from South-West to South-East, the velocity at the same time increasing considerably. A calm, lasting from 4 to 7.20 A.M. of the 5th, was succeeded by a westerly wind, which veered to the South at 10 A.M. On the 10th, at 3.30 A.M., the direction changed suddenly from West to North, then gradually to South-East, the velocity increasing.

During the 13th, there were numerous changes. At 9 A.M., it veered from South-East to West, returning to South-East at 10.20. Between 4 and 7 P.M., it again became West, and shortly after, South-West; the velocity during the day was nearly constant at eleven miles per hour. At 7 P.M. on the 15th, the velocity very much diminished, but increased at 9, the direction changing from South to North-East.

On the 18th the wind went from East to South-West between 2 and 5 P.M., and at 7.15 the next morning, from South-West through North to East. It continued in that point with a velocity of ten miles until 1.50 P.M., at which time it became calm; but at 2.20 it recommenced at the same rate from the North, where it remained until midnight of the 20th, when a calm followed.

On the 22nd, there was increasing force from the South-West at 5 A.M., and the velocity augmented until it was forty miles per hour

at noon: this was the most violent wind recorded during the month —six hundred and seventy miles were registered by the anemograph as having passed over it in twenty-four hours.

During the night of the 26th, the velocity ranged from twenty to thirty miles.

SEPTEMBER, 1868.

ATMOSPHERIC PRESSURE.—The general movement of the barometer during September was downwards.

The mean height on the 1st was 30·191 ins.; on the 2nd, it was a little higher; but a slight depression followed on the 3rd and 4th. During the 6th, the barometer fell, giving a mean on the 7th of 30·012 ins., but, ascending rapidly through the 8th, arrived at the maximum height of the month on the 9th—30·319 ins. After noon on the 9th, the fall was continuous until midnight of the 10th.

The mean for the 11th was 29·976 ins. Very few variations of pressure were recorded until the 17th, when the barometer again went down. The instrumental curve shows several fluctuations on the 8th; the fall which commenced on the 7th continued until 2.40 P.M.; the barometer then rose rapidly during half an hour, when it changed, and fell. At 6.10 P.M., the movement again became upward; at 8.10, the pressure diminished, and at 9.30 P.M. was stationary. The mean height for the day was 29·532 ins.

The readings increased to 29·686 on the 21st, after which there was no variation until the 29th; on that day they were depressed to 29·418 ins.

From 29·666 ins. on the 26th, there was a gradual diminution of the means to 29·289 ins. on the 30th, which was the minimum of the month.

At 10.30 A.M. of the 29th, and at 1.50 P.M. on the 30th, sudden rises of the barometer were registered of 0·035 ins. and 0·042 ins. in extent.

The mean height for the month was 29·829 ins.

TEMPERATURE OF THE AIR.—The mean daily temperature increased from 61·3° on the 1st to 68·1° on the 4th, and from 64·7° on the 5th to 70·1° on the 7th. On this day, the thermometer fell very rapidly from 5 to 8 P.M., and continued falling throughout the night. On the morning of the 7th, it fell from 6 to 8, afterwards going down all the day, giving a mean of 59·3°.

The mean temperature varied very little from this until the 13th, when it diminished to 55·6°. At 9.40 A.M. on the 11th, the thermometer suddenly rose 6°. There were great fluctuations in the temperatures recorded on the 16th, and also on the 18th, on which

day the curve showed a continuous fall from 11.50 to 0.30 P.M.; the thermometer then went up rapidly until 2 P.M.; at 3.30 P.M., it again went down, and rose immediately. This was repeated at 8.15 P.M. Similar variations were frequent during the night, but to a less degree.

The 20th was a little warmer than the preceding days, the mean being 60·7°. Numerous fluctuations were also registered on the record for the day. After the 20th, the means gradually diminished to 54·3° on the 25th. The temperature curve was very irregular on the 26th, showing a sudden depression of the thermometer at 1 P.M., and again at midnight; there was also a depression of 5°, which lasted from 2.40 to 3.55 the morning of the 27th. Sudden falls of temperature, all of which were simultaneous with heavy showers, were registered as follows:—on the 29th, at 10.30 A.M., of 7°; at 12.15, of 3°; and at 1.30, of 6°: on the 30th, at 1.45 A.M., of 5°; and at 1.50 P.M., of 9°. The mean temperature of the 30th was 52·8°, the lowest in the month.

The highest maximum temperatures were 85·7° on the 5th, and 86·4° on the 7th; the lowest were 61·5° on the 14th, and 61·8° on the 28th.

The highest minima were 55·8° on the 12th, and 54·9° on the 20th; the lowest were 41·1° on the 11th, and 43·6° on the 25th. The largest daily range was 35·1° on the 5th; the least, 10·1° on the 28th, the mean being 19·1°.

The mean temperature for the month = 59·1°.

Relative Humidity.—The variations in the hygrometric state of the air were considerable during September.

The greatest dryness was 0.51 on the 13th; the 25th showed the least, 0·94. The mean for the month = 0·74.

Rainfall.—The quantities of rain measured were as follows:—

18th	0·010 ins.	26th	0·160 ins.
19th	0·660 „	27th	0·560 „
20th	0·020 „	28th	0·080 „
21st	0·010 „	29th	0·220 „
25th	0·060 „	30th	0·160 „

The total fall during the month being 1·940 ins.

Wind.—The general direction of the wind was:—

North—22nd.

North-East—8th, 12th, 13th, 14th, and 15th.

East—9th, 10th, 11th, 19th, and 21st.

South-East—6th, 16th, and 17th.

South—18th, 20th, 25th, and 28th.

South-West—2nd, 3rd, 4th, 7th, 26th, 27th, 29th, and 30th.

West—1st, 23rd, and 24th.

The wind was calm from 3.40 to 8.30 A.M. on the 2nd; and during the day, changes of direction were frequent. Until 3.15 P.M., it fluctuated from South-West to South, but then became West. At 6.25 P.M., it veered to North-East, and at 8.5, from North-East through East and South to South-West, where it remained. The velocity was very low during the 7th; but at 7 A.M. of the 8th, increased to twenty miles per hour, which rate was maintained until the evening of the 9th. At 8.5 on the 11th, the wind veered from North-East to South, returning at 9.45 to East. The velocity ranged from twenty to thirty miles per hour through the 12th and 13th. On the 17th, it was also thirty miles from 10 A.M. to 8 P.M.

On the 18th, the direction, which was East-South-East, changed to South-West, but at 9 P.M., again became East-South-East; and on the 25th, at 3.15 A.M., there was a change from South-West to East. The same day, between 3 and 5 P.M., it shifted gradually round from East to South-West, the velocity at the time being twenty-five miles. Between 2.10 and 3.50 P.M. of the 27th, the wind made a complete circuit, from South through West to North and East to South. At 8.20 P.M. of the same day, the velocity increased to twenty-five miles, and remained high until 8 P.M. on the 30th.

THE HYALONEMA CONTROVERSY.

In the tenth volume of the "Intellectual Observer" (p. 81), our readers will find Professor Wyville Thomson's paper on the "Hyalonema or Glass-Rope Sponge," which has formed a subject of continual controversy between Dr. Gray, Dr. Bowerbank, and other naturalists. No one knew exactly how the sponge grew, and what relation its long bundle of silicious threads bore to the rest of the organism. This bundle of threads was frequently encrusted with a leathery substance, covered with warts, which most naturalists regarded as polyp cells, but which Dr. Bowerbank, who does not seem to have paid enough attention to the labours of other students, took for excretory orifices of the sponge. Dr. Brandt of St. Petersburg, was successful in demonstrating the existence of the polyps, and they were shown very plainly in sections of the cells made by Mr. Charles Tyler, and exhibited in 1867 at several microscopic

soirées in London. Dr. Gray—as expressed in Professor Wyville Thomson's paper—was led by some insufficient analogies to regard the glass-rope as formed by the polyps, and Brandt followed his views. Max Schultze referred the glass-rope to the sponge, and treated the polyps as parasites, which view was supported by Wyville Thomson.

In 1864 Senhor B. de Bocage discovered the "glass-ropes" on the coast of Portugal, covered with the polyps, but without the terminal sponge. This seemed to confirm Dr. Gray's ideas, but did not change the opinion of Wyville Thomson and other cautious reasoners on the subject.

For details and illustrations of the structure of the Hyalonema, we must refer to Professor Wyville Thomson's paper. Our object now is to note the more recent results of investigation.

In the "Annals of Natural History," for October, Dr. Gray describes what he calls "a new free form of *Hyalonema Sieboldii*, and its manner of growth," and reiterates his previous opinions. Without any adequate reason he assumed that specimens picked up without adherent sponges, were "free forms" of the coral-like polyp; he thought "all difficulties would disappear," if the formation of the glass-rope by the polyps were assumed. He reviews the grounds on which Schultze treated the glass-rope as a sponge formation, and expresses his belief that "it is quite possible that the *Hyalonemata* live with the silicious filaments sunk in the sand." He added "a dealer, more than two years ago, showed me a number of coils in the state in which he received them from Japan, in which the exposed filaments of the coil were covered with mud, and he said that the collector told him that they lived with part of the coil sunk in the mud. I did not credit the account then, but I see reason to do so now." The upper part of the "coral," as he calls it, is, he says, often taken possession of by a cup-shaped parasitic sponge, "which destroys the polyps." It is curious that Dr. Gray's controversial zeal blinded him to all the dubious points of his theory, and that he should have explained the existence of glass-ropes without the polyps (*Palythoa*) or with other parasites, by supposing that the leathery layer had been eaten by fishes or rotted away, so that the glass threads were exposed, and either remained in that state or became connected with a new form. If he had argued more logically he would have treated the absence of the polyps from some specimens as being equally important as the absence of the sponge from others. A very weak point of his reasoning was also shown in the readiness with which he assumed the long threads to be the product

of a coral and not of a sponge, although no satisfactory evidence of the supposition could be adduced.

Professor Percival Wright, we are told, in the "Annals of Natural History" for October, has just returned from examining the Hyalonema ground at Setubal, with the help of M. de Bocage. He discovered the "glass-ropes" imbedded in the mud as the collector informed Dr. Gray, was their habit, and he regarded this rope as the silicious axis of the sponge. "The sponge mass," he said, "is provided with a number of oscula looking upwards, these being covered over by a beautiful open network of spicules. When the sponge mass is washed away, or destroyed, the parasitic *Palythoa*, which was seen living and in the act of protruding its tentacles, grows up over that portion of the silicious axis which is left uncovered by the mud."

We lately mentioned that Dr. Carpenter was going out in company with Professor Wyville Thomson on a deep-sea dredging expedition, which, notwithstanding rough weather, proved highly successful, and has in a great many ways added to the general stock of scientific knowledge. Professor Wyville Thomson undertook the examination of the sponges, and, pending a complete investigation, sent a note to Dr. Gray, stating that "in the gulf stream, at 550 fathoms, we got *Hyalonema* upside down, as I already suspected from Lovén's paper, but besides *Hyalonema* we got at least half-a-dozen new forms of vitreous sponges most remarkable, and some of them as beautiful as the flower basket."

We understand that the parasitic nature of the *Palythoa* is also settled by the objects collected in these dredgings, and thus the controversy may, we suppose, be regarded as at an end.

WOMANKIND:

IN ALL AGES OF WESTERN EUROPE.

BY THOMAS WRIGHT, F.S.A.

CHAPTER VII.

WOMANKIND IN THE FEUDAL CASTLE—WOMAN'S POSITION IN THE HOUSEHOLD—CHIVALRY—THE RELATIONS OF THE SEXES—LOVE.

In a former chapter I have described in general terms the change brought upon society by the feudal system, and especially on woman's position in it. We may contemplate these, in their full extent, in the literature of the thirteenth and fourteenth centuries, in the romances of which the subjects are taken from contemporary life, in the tales and histories, in the poetry of every description.

As a wife, woman had become, instead of the slave and property of her husband, his equal, and in most of the relations of life an independent agent. She had become capable of holding independent power of her own, which was something more than reflecting that of her husband. She was now an heiress, and carrying with her as her dower castles, and domains, and provinces, with numerous vassals; she could be guardian of the manor, regent of the state, and as such sign deeds, and share in all the obligations imposed by peace or war. Many of the great ladies of the middle ages ruled over extensive territories, and took a very active part in political affairs. In the household her position had more of dignity in it, and she was looked upon with a different kind of respect. Instead of serving the wine to the guests, she sat at the table, and hers was the place of honour, by the side of her lord. The accompanying picture of a mediæval party at table is taken from an illumination of the fourteenth century, in the Imperial Library in Paris. When her lord was absent, she was at the head of the board. If a visitor of any rank came to the

A DINNER PARTY OF THE FOURTEENTH CENTURY.

castle during the absence of the lord, the lady received him, provided for his wants, led him to the table herself, and seated him by her side as in the place of honour.

This was the case even if the stranger came in the night. In a fabliau printed in the collection of Barbazan (iv. 370), the lady of a castle, possessed of rather a contradictory temper, received a visitor into the castle in despite of the orders of her husband. This example we may consider as belonging to the thirteenth century. In one of the stories in that curious collection, the Cent nouvelles Nouvelles (Nouv. 81), a knight and his company, overtaken by darkness and inclement weather, reach the gate of a castle. It was "late," for it was nine or ten o'clock in the evening, and the people of the castle were already hastening to their beds. The lord of the castle was absent, but when they announced the arrival of the visitors to the lady, who was in her chamber undressed for bed, she said, "They are welcome; quick, kill poultry, and bring forth whatever we have for their supper." And in haste she took her night robe, and thus, dressed as she was, she came courteously to meet the aforesaid lords, with two torches before her and a single woman with her, "a very handsome damsel"; the others were preparing the chambers. She came to meet her guests on the bridge of the castle, and the gentle knight advanced, and, thanking her, kissed her, as did the others also. And so they were received into the castle, and treated to supper before going to bed. It seems, indeed, to have been the special duty, or, at least, the general custom, for the lady of the castle to go to the gate to receive the visitor. In one of the drawings in a fine illuminated manuscript in the British Museum (MS. Reg. 15 E. VI., fol. 159, r°), a noble knight, who has left his military escort outside and passed the outer gate, is met by the lady Chatelaine, who advances from the inner gate towards him. In the book of the "Très chevalereux Comte d'Artois," when the Comte d'Artois pays a visit to the Countess of Boulogne in her castle, she similarly comes out, with her fair daughter, to receive him at the gate, and she takes him by the hand and leads him into the hall, where he finds dancing and minstrelsy. The manner in which the countess received the visitor is shown in a drawing in the illuminated manuscript, a copy of which is given in the accompanying cut. It will be seen that the Comte d'Artois and his esquire are entering by the outer gateway, while the ladies are issuing from the interior of the castle. Sometimes, of course, it must have happened that the lady was found in a state of unreadiness, and then he was introduced into the castle, and awaited her in the hall. Such is the

case in the "History of the Châlelain de Coucy and the Lady of Fayel," where, on the unexpected arrival of the former in the

RECEIVING A VISITOR.

absence of the husband, he is obliged to wait in the hall while she hurries to her chamber to dress; but this operation is soon performed, for, as the author says, "a fair lady is quickly arrayed"—

Car belle dame est tost parée.

But this delay in receiving the guest appears not to have been considered courteous, and occurs seldom in the romances or tales. The knight of La Tour-Landry urges that "all women should come to receive their friends in the state in which they happen to be," and he tells a story of a knight who was accustomed to make distant voyages, and who had two fair nieces, well married, to both of whom he was much attached. In one of his voyages he bought each of them a very rich robe, and on his return he proceeded

direct to the house of one of his nieces, and announced his arrival. The lady shut herself up in her chamber to dress fine, and sent word to her visitor that she would come soon. The knight was thus kept so long waiting, that he lost patience, and so, remounting his horse, hastened to the house of the other neice, who had at that moment a caprice of making bread, and was thus occupied with her hands all covered with paste. So soon, however, as she heard that her uncle was at the gate, she hurried just as she was, to welcome him, led him to his chamber, and so soon as he

THE GUEST'S DEPARTURE.

was safely lodged, went to her own chamber to dress, that she might appear before him in a guise better fitted to do him honour. The uncle was so charmed with her behaviour, that he gave her the two robes, and withdrew his love from the other.

When a guest departed, it appears to have been the practice for the lord and lady of the castle to conduct him to the gate. A scene of this description is represented in the accompanying copy of one of the beautiful illuminations to the Roman de la Violette. Gerard of Nevers, the hero of this romance, has relieved the family of the castle of Bien-Assis from the persecutions of a brutal giant,

and is here represented taking his leave of its lord and lady at the gate. It must be explained that their beautiful daughter has fallen violently in love with Gerard, whose heart, however, is otherwise engaged. As he mounted his horse, the young lady, who appears to have been in bed, was suddenly informed of his departure, and, throwing over her body a *bliault*, or loose robe, she hastened down into the yard. We have here a good picture of a lady in undress. Her condition may be best described in the words of the original:—

Gerars monte, plus ne demeure,	Gerard mounts, he remains no longer,
Sour le cheval, l'espée çainte.	On his horse, his sword girded on.
La fille au signor vint deschainte,	The lord's daughter came ungirt,
Acourante, quant ot la nouviele,	Running to him, when she heard the news.
Em pur son bliaut fu la biele,	In her mere bliault was the fair one,
Sans gimple, un chapel d'or el chief;	Without wimple, a chaplet of gold on her head;
Mais dire vous voel de rechief	But I will tell you again
K'encor estoit ses chiés plus sors	That her head was still fairer
Et plus reluisans que li ors	And more shining than the gold
Qui fu el chapial, che m'est vis.	Which was in her chaplet, it appears to me.
La freche colors de sen vis	The fresh colour of her face
Fu assés miex enluminée	Was much more brilliant
Que ros en Mai, la matinée.	Than a rose in May, in the morning.
* * * *	* * * *
Le cors avoit bien fait et gent,	Her body was well-made and graceful,
Les mains bien faites et les bras.	Her hands well-made and her arms.
Un poi ot soslevé ses dras,	She had lifted her clothes a little,
Se li paroit li piechonnés	So that her little foot appeared,
Blans et petis, bien fait et nés.	White and small, well-made, and clean.

It may be remarked that the text of this romance is of the thirteenth century; while the illuminations belong to a prose version of it in a manuscript of the fifteenth.

As the lady of the castle sat by her husband at the table, so also when not at their meals they sat side by side on one seat, similar to what we now call a settle, as shown in the accompanying cut, which is taken from an illuminated manuscript of the fourteenth century in the Imperial Library at Paris. When a visitor came, or when

THE KNIGHT AND HIS LADY.

she would converse with a gentleman whom she held in esteem, the lady of the house took him by the hand, and placed him in the seat of honour by her side.

The lady of the castle, too, had the direction and control of the whole family, which was often very numerous. This arose out of the spirit of feudalism itself, under which it had become the practice for the vassals, or feudatories, to send their sons to be educated in the family of their suzerain, while the daughters were similarly placed with the lady of the castle, who had thus in attendance upon her a retinue of young damsels, all claiming the honorary title, for none were admitted to it who were not of gentle blood, of *chambrières*, or chamber-maidens. These formed a very important part of the household.

They were all, as daughters of gentle blood, entitled to be called *damoiselles*, *i.e.* little dames, as those of the other sex were to that of *damoisel*, or little lord, and their intercourse among themselves, and with the *damoiseaux*, including the daughters and sons of the lord of the castle, was on a perfect footing of freedom and equality. During the earlier part of the day, these *chambrières* remained by themselves, in their chambers, or in that of their lady, in work of different descriptions, but all tending to the production of articles

DAMOISELLES AND DAMOISEAUX.

of dress or decoration of the person. After dinner, until the time of supper, they joined in society with the young *bachelors*, as all

those were termed who had not yet attained the rank of knighthood, in the chambers, or in the garden, where they indulged in a variety of games and amusements. The opposite cut, from an illumination in the manuscript of the "Livre du très chevalereux Comte d'Artois," of the fifteenth century, furnishes a good picture of a party of these damoiselles and damoiseaux engaged in conversation in the chamber. It will be observed that all the damsels, with one exception, present the same character of formality and demureness in the posture in which they are seated, and especially in the manner in which they hold their arms and hands. There is a character of conventionality about them which has evidently been taught, even to the holding of the hands crossed. This fashion continued long to exist, for in one of the comedies of Larivey (the latter half of the sixteenth century), "Le Laqanis," one of the characters, act iii, sc. 4, says, "Poor girl, she would be a very fool to remain for ever with her *hands in a cross* on her apron, till her father marry her." The same conventionality is seen in the second group, which is taken from an illuminated manuscript of perhaps rather earlier date, in the Imperial Library in Paris.

A SOCIAL PARTY IN CONVERSATION.

Several short codes of instruction in behaviour for young ladies in the middle ages have been preserved, and they are in many respects curious. The earliest apparently of these is in verse, by one Robert de Blois, and belongs to the thirteenth century. It was printed by Barbazan, under the title of "Le Chastiement des Dames," and is written in verse. Robert exhorts the fair sex not to talk too much, to be courteous and modest before gentlemen; when walking out, not to go on a trot, or a run, but to walk straight forward at a steady pace, and not to advance before their companions. "Running and trotting, your own heart will tell you, are not becoming in a lady."

En vostre cuer poez pensez
Que le corre ne le trotar
A dame jà bien ne serra.

The ladies are not to amuse themselves by turning their eyes right or left as they walk along, but to look straight before them, and to salute courteously all they meet. They are not to let men put their hands into their bosoms, or kiss them; and the poem goes on to treat almost entirely of love matters, which seem to have been the great subject of conversation and thought. The worthy Knight of La Tour-Landry, in the middle of the fourteenth century, instructs his daughters in a somewhat similar spirit; and that curious book, the "Menagier de Paris," written about the year 1343, is still more particular. "If you are walking out," the author says, "go with your head turned straight forward, your eyelids low and fixed, and your look straight forward down to the ground, four toises (twelve yards) before you, without turning your eyes on man or woman, to the right or to the left, or staring upwards, or moving your eyes about from one place to another, or laughing, or stopping to talk to anyone in the streets." Mr. Furnivall has printed, in his "Babees Book," a similar little code of instructions for damsels of the first half of the fifteenth century, written in English verse, and entitled in the manuscript, "How the good wyfe taughte hir doughtir." These counsels are of a description similar to the others, and they all show the character of demureness and conventionality which was, during the middle ages, considered to be most becoming in the fair sex, at least when young. Our third example of females conversing, taken from a manuscript of Froissart, of the fifteenth century, exhibits somewhat more energy of action.

LADIES IN CONVERSATION.

Under all these circumstances, there arose a new tone of sentiment between the two

sexes, or at least one which had not been felt in the same form before. The lady of the castle, as the head of the household, represented Womankind in full consciousness of independence and self-confidence, and this consciousness had been communicated to the rest of the sex within the castle-walls. When woman obtains this position, it immediately makes itself felt upon the other sex, and under it the harshness and ferocity which were naturally the first characteristics of feudalism, were gradually exchanged for elegance of manners, and sentiments which were new to society. Out of this new state of things arose two words which will never be forgotten. The first of these is *courtesy*. Every great baron's household was a court, and courtesy meant simply the manners and sentiments which prevailed in the feudal court. One of the later almost medieval Latin writers has said, using the Latin form of the word, "*Curialitas est quasi idem quod nobilitas morum*"—"Courtesy is the same thing as nobility of manners." Courtesy was, over everything, that which distinguished the society inside the castle from that without, from the people of the country, and from the *bourgeoisie*, and the middle ages universally allowed that it was the influence of the female sex which fostered it. A little poem of the thirteenth century, published by my friend M. Jubinal, in his volume of "Jongleurs et Trouvères," expresses this sentiment in strong terms :—

Assez i a reson por qoi	There is reason enough why
L'en doit fame chière tenir ;	We ought to hold woman dear ;
Quar nous véons poi avenir	For we see happen very little
Cortoisie, se n'est par fames.	Courtesy, except by women.
Bien sai que por l'amor des dames	Well know I that for the love of the ladies
Devienent li vilains cortois.	The very clowns become courteous.

I know nothing more beautiful than the sentiment of the chapter of the book of La Tour-Landry, in which he recommends the duty of courtesy to his daughters.

The other word which we owe to the influence of Womankind on feudal society is *chivalry*. It indicated a spirit which arose from the same source. "Woman," says the poem just quoted, "is of such nature, that she makes the coward bold."

Fame si est de tel nature,
Qu'ele fet les coars hardis.

Woman's position once established in the form it had now taken, its influence was natural. Dame and damoiselle learnt to value the other sex chiefly for his bravery and for his skill in battle—he soon learnt to treasure the approval of that sex whose smiles he had sought within the castle walls, for the acts of prowess which had

distinguished him outside. Mixed up with this was a spirit of gallantry which had made its way from the south, from Italy, and la belle Provence. The knight learnt to look upon woman as his patron and mistress, and upon himself as her servant, and as bound to offer himself in her defence. It was this feeling of devotion which obtained the name of *chevalerie*, it was the moral duty of the *chevalier*. The duties of the knight towards the lady are thus defined in the "Ordene de Chevalerie" of Hugh de Tabarie, printed in Barbazan—

Dame ne doit ne damoisele	He ought neither dame nor damoiselle
Por nule rien fourconsillier;	To misadvise on any account;
Mais, s'eles ont de lui mestier,	But, if they have need of him,
Aidier leur doit à son pooir,	He ought to aid them with all his power,
Se il veut los et pris avoir;	If he will have praise and respect;
Car femes doit l'en honourer,	For we ought to honour women,
Et por lor droit grans fez porter.	And for their right undergo great fatigues.

But though all these principles of chivalry and gallantry were universally acknowledged and talked of, the things themselves soon sank into forms and matters of show and ostentation, and they were displayed to most advantage in the romances. Chivalry, in show, belonged to the tournament and the joust, of which the ladies were looked upon as the special patrons, and he was considered the most gallant who most skilfully carried off their favours. It was his lady who sent him into the combat, and she sometimes led him to the field by his bridle, or even by a chain, and he proclaimed himself her servant. The knights were all, as they pretended, the servants of love," or "of beauty." At the great tournament in Paris in 1389, given by Charles VI., on the second day the knights who were to combat were conducted to the field by twenty-two damoiselles. It was the office of the ladies—sometimes especially of the damoiselles—to dress the combatant. They sometimes armed the knight for the combat, as in the Roman de la Violette, whêre (l. 227) the knight's daughter gives Gerard his helm—

La puciele, l'ielme li baille.

Generally each lady had her particular favourite, to whom she gave some object for which he was to fight. Sometimes the favour was a scarf, or some article of the lady's own dress, which he hung to his lance or helmet, or attached to some part of his armour. In more than one instance the lady gives as her favour to the knight of her choice her *chemise*. More frequently the token was a sleeve. In the romance of Flamenca, the king carries Flamenca's sleeve on his lance, and thus excites the queen's jealousy. In the "History

of the Châtelain de Coucy," on the announcement of a great tournament which was to be given at the castle of Fayel, the lady of the castle, at his request, promises to make him a large embroidered sleeve, that he may be her champion in the combat, to which he comes in very rich armour. After the service of mass, the ladies, who were the witnesses and judges of the tournament, mount to the stage which was prepared for them—

Tost fu mainte dame montée	Soon was many a lady mounted
Pour véoir et pour esgarder	To see and to consider
Ceulx qui veullent honnour garder,	Those who will keep honour,
Et mettre cuer et corps et ame	And employ heart and body and soul
Pour l'amour d'onnour et de dame.	For the love of honour and of the lady.

In the hottest of the combat, when the Châtelain de Coucy was bidding fair for the victory, then the heralds shouted out to the lady spectators—

Dames, or povés esgarder.	Ladies, now you may look at them.
Donner les doit-on par soulas	You ought to give them for encouragement
Manches et aguilliers et las,	Sleeves, and needle-cases, and laces,
Les savoureus baissiers promettre.	Promise them the delicious kisses.

We shall give with the next chapter a coloured plate, from an illumination of the fifteenth century, representing these lady spectators and judges on their stage. In the earlier period, men sat indiscriminately with the ladies on this stage, but in the fifteenth century, when feudalism was at its last gasp, if not earlier, it appears to have been reserved entirely for the ladies.

It was the right of the ladies also to judge and pronounce who of the combatants in the tournament merited the prize. At the tournament in Paris in 1389, according to the monk of St. Denis, who has left us an account of it, the ladies met after supper on each day, and adjudged the prize of valour, and their judgment was immediately confirmed by the king. The prize, which was presented by one of the ladies, was usually in the form of a crown or chaplet, which was called the *chapelet d'honneur*, but it was sometimes in the form of a collar. When the *tres chevalereux* Comte d'Artois, as his book tells us, proved himself the most valiant combatant in the tournament at Boulogne, the prize, which consisted of a collar of gold, was placed round his neck by the fair hands of the beautiful daughter of the Count of Boulogne, and in performing this duty she addressed to him the words, "*Monseigneur, comme ou mieulx faisant de toute la journée, les dames vous font présent de cest chappeau, en vous priant que le vuilliés prandre en gré.*"

Scenes like this were not unfrequently pourtrayed upon the orna-

mental objects belonging to the ladies' toilette, and especially upon the covers of their mirrors, which were usually of ivory. One of these, of the latter part of the thirteenth century, has been engraved by Paul Lacroix and Seré, in their great work "Le Moyen Age et la Renaissance," from which it is copied in the accompanying cut—

DISTRIBUTING THE PRIZES OF THE TOURNAMENT.

it represents the ladies adjudging and distributing the prize of valour to two combatants in the tournament. The prizes are either chaplets or collars, and the proceedings are directed by the queen of the tournament, who stands above with her sceptre in her right hand, and a falcon on her left. To judge by what is taking place in

the centre of the picture, we may suppose that at this time ladies were not the only persons admitted on the stage. Perhaps it is another successful competitor, for one of the advantages gained by the victor was the right of kissing at his will the fairest of the ladies present.

The ladies of these periods were generally so fully persuaded that the merit of the other sex consisted chiefly in bravery and warlike exploits, that sometimes a fair maiden became inaccessible to all softer charms, and, resolved to have at least a brave husband, offered herself as the prize of the tournament. Of course she was a damoiselle of rank and wealth, and worth fighting for. This was the case in our own country, according to the history of the Fitz Warines, with the fair Melette of Whittington, who refused to take for her husband anybody but one who should be "handsome, courteous, and accomplished, and the most valiant of his body in all Christendom." Her uncle proclaimed a tournament, and offered Melette with the manor of Whittington as the prize. Guarin de Metz so distinguished himself on the first day that he gained the lady's love, and, the next day, she sent him her glove for a favour, and asked him to defend it. Somewhat similarly, in the charming *romance* or ballad of "Bele Idoine," the king, her father, proclaims a tournament, at which Idoine is to be the prize.

But these were comparatively rare cases. The damoiselles of the feudal period were very susceptible to the passion of love, which was, indeed, the ruling spirit of the society within the castle—the moving power of life—as we are told in the opening lines of the "History of the Châtelain de Coucy"—

> **Amours, qui est principaument**
> **Voie de vie honnestement.**

The young damoisel in the household of the castle was constantly making love to the damoiselle, and labouring to seduce her, and she was but too ready to listen to him. Feudal society was, in comparison to what had gone before it, polished and brilliant, and presented many great qualities, but under the surface it was not pure. This may be accounted for by many circumstances in the texture of mediæval society.

First, nearly the whole society in the castle mixed together on something like a footing of equality, and where the lord of the castle appointed one of the young bachelors to serve one of his daughters, it might, and, according to the romances, sometimes did, end in marriage. During a considerable portion of the day, the

damoiselles and the damoiseaux were engaged in playing together at different amusements and games, and we can perceive in the description that these were often suggestive of anything but chaste feelings, while the language in common use among both sexes was far from delicate. All these were combined with an extreme intimacy between the two sexes, who commonly visited each other in their chambers or bedrooms. Thus, in the poem of Gautier d'Aupais, the hero is represented as visiting in her chamber the damoiselle of whom he is enamoured. Numerous similar examples might be quoted. At times, one of the parties is described as being actually in bed, as is the case in the romance of Blonde of Oxford, where Blonde visits Jehan in his chamber where he is in bed, and stays all night with him, in perfect innocence, as we are told in the romance. We must remember that it was the custom in those times for both sexes to go to bed perfectly naked.

Then theories about love, and sentiments of a very free character, springing probably out of the old licence of the lower empire, had established themselves in the south of France—in Provence—and had spread through the whole extent of feudalism. Making love was considered the great business of social life, and rules and forms were laid down for carrying it on properly. The manner in which, in the story of Jehan de Saintré, the dame des Belles Cousines, instructs the youth in love is quite edifying. In the romance of Floire and Blanceflor, the king, Floire's father, puts them to schooling together when still very young, and love was one of the first sciences they began to learn.

Et quant à l'escole venoient,	And when they came to school,
Lor tables d'yvoire prenoient.	They took their tablets of ivory.
Adont lor véissiez escrire	Then you would see them writing
Letres et vers d'amors en cire.	Letters and verses of love on the wax.
Lor graffes sont d'or et d'argent,	Their styles are of gold and silver,
Dont il escrivent soutiument;	With which they write cunningly;
Letres et salus font d'amors,	They make letters and saluts (*a sort of verse*) of love,
Du chant das oisiaus et des flors.	Of the song of birds, and of flowers.
D'autre chose n'ont il envie.	They have no desire of aught else.
Roman de Fl. Blancef., l. 250.	

Thus, it became one of the great accomplishments of a young bachelor, as well as of a knight, to write love verses upon his lady. When Gautier d'Aupais could make no impression on the hard heart of the object of his affection, he consulted a minstrel, who advised him to compose a song in her praise, setting forth his passion, and that he should cause it to be sung in her presence by some one

whose profession it was to sing. Gautier did so, and was successful. This knightly love-poetry formed once a large body of literature, and much of it is preserved. The chansons of the Chatelain de Coucy form a substantial volume. These compositions were distinguished by the title of *Romances*. My friend, M. Paulin Paris, has given a selection of them in his charming little volume, "Le Romancero François," which includes romances by kings and dukes and great barons. Such poets were still more numerous in Provençal, and among them we have to reckon our own lion-hearted king, Richard I.

We may easily understand how all these causes would join in giving a great licence of tone and character to female society during the feudal period. In our history of the Fulke Fitz Warines, the intrigue of Sir Arnauld with the fair damoiselle, Marion of the Heath, in Ludlow castle, is not told as an occurrence which was at all unusual.

FLOODS FROM ANCIENT GLACIERS.

BY E. COLLOMB.

M. E. Collomb lately sent the following paper to the French Academy:—

As diluvial currents have played a considerable part during the long continuance of ancient glaciers, it is interesting to considor what volume of water may have been given out in a certain time by a glacier whose perimeter is known. We may, for this purpose, base our calculations upon the study of phenomena now established by glaciers now in action, and compare their work with analogous operations in former times.

Thanks to the exact observations, made in 1844 and 1845, by MM. Dolfuss and Desor, in the glacier of the Aar, we know that the torrent rushing from it, carefully gauged, poured forth, between 20th July and 4th August, a mean quantity of 1,278,738 cubic metres a day, the maximum being 2,100,000, and the minimum 780,000 cubic metres. This maximum does not correspond to the great floods following continued rains, or the sudden melting of snow by the *fœhn*, but represents what occurs in an ordinary day in July, with a mean temperaure of 6°·5 C.

The same observers were not content with noticing the phe-

nomena in summer; they also studied them in winter, both in the glacier of the Aar and in those of Grindelwald and Rosenlaüi, in which season the melting is reduced to zero, and if streams still occur, they arise from other sources.

The glacier which pours out 2,100,000 cubic metres a day has an altitude of 1877 metres from the foot of the terminal talus, and proceeds from a hydrographical basin of about fifty-two square kilometres. The compact ice, on a summer day, has only a surface of eight square kilometres, the remaining forty-four kilometres being occupied by the *nevés*, the upper snow-fields, rocks and peaks, amongst which stand the Finsteraarhorn, taking up 4275 metres.

Starting from this datum, that a glacial surface of fifty-two square kilometres pours forth 2,100,000 cubic metres of water a day, how much did the ancient quaternary glaciers give out in the same time?

To answer this, let us first take, for example, one of the great glaciers of the Alps, west of the Rhone. It encumbered a whole upper valley of the Rhone, from Galenstock to the Lake of Geneva, a length of 150 kilometres: from thence it extended, fan-like, over the whole surface of the lake, and its front occupied at a given time the shore between Mont Sion, near Geneva, to beyond Soleure. Its frontal moraines were deposited on the western slopes of the Jura. This glacier, with its geographical basin, its snow-fields and peaks, occupied a surface of 12,600 square kilometres. Adding to it the ancient glacier of Chamouni, comprising the hydrographical basin of the Arve and that of the Drome, whose waters meet those of the Rhone glacier, and which occupy a surface of 15,000 square kilometres, the whole ought, if they acted like the glacier of the Aar—which is not an exaggerated supposition—to have poured forth 605 millions of cubic metres a day; rather more than 7000 cubic metres a second, on a point situated a few kilometres below Geneva.

The actual Rhone, at Geneva, gauged by General Dufour on 24th September, 1840, at its flood, gave a result of 424 cubic metres; the Rhine, at Kehl, at low water, 350; in medium state, 956; and in full flood, of 4685 cubic metres.

Another example, taken from the Pyrenees—that of the glacier Argelés, show that when its terminal moraines were deposited at Adé, near Tarbes, it occupied a hydrographical basin of 1200 square kilometres, consisting of the principal valley of the gorge of Pau, and that of Cauterets, Labat, and the valley of Arrens, whose waters join at Lourdes. These 1200 kilometres, according to the same calculation, would have emitted 48 millions of cubic metres a

day, or 555 cubic metres in a second. From Lourdes to Pau, the mean fall is 0mm. 005, sufficient slope to give a violent impulse to this mass of water.

We shall hereafter continue our calculations of other ancient glaciers, whose hydographic basins are known; but we now see—from the two examples given of these glacial torrents under ordinary circumstances, and independent of great floods, the particulars of which are not known—that they must have been greater, and almost double that of the Rhine at Kehl during the greatest meltings.

If glaciers played an important part in quaternary epochs, their mechanical effects of transport of materials and erosion of rocks must have been limited by their perimeters, while the torrents or rivers flowing from them made their action felt beyond those bounds. Their waters were loaded with sediment like those of to-day. From careful observation, it is found that the waters issuing from the Aar carry on the upper surface of their currents 0 gr. 142 of fine silt per litre, while at the bottom of the torrent bed much larger masses are transported. This 0 gr. 142, multiplied by these 605 millions of cubic metres a day, of the ancient glacier of the Rhone, gives 86 million kilogrammes of sediment—86,000 metric quintals a day.

This great mass of sediment, the transport of which continued as long as the ancient glaciers, is chiefly deposited in the valleys which their streams washed, and contributed a considerable portion of the loess, the origin of which has hitherto been so problematical.

ARCHÆOLOGIA.

THE two past months have witnessed several antiquarian discoveries, one or two of which have given rise to a considerable amount of discussion.

Early in September the TOMB in Winchester cathedral, understood to be that of WILLIAM RUFUS, was carefully opened and examined. The original tomb is stated to have stood in the middle of the choir within the area of the tower, but at some period afterwards it was removed thence to the spot which it has occupied ever since, in the ancient sanctuary, near the altar, and between the north and south doors of the choir. It was opened under the direction, and in the presence of, the Rev. Canon Jacob, Archdeacon and Vice-Dean of Winchester, and some of the leading surgeons and authorities of the town. Inside were found all, or very nearly all, the bones of a skeleton, much displaced, and some of them broken, so that the period at which they were removed must have been sufficiently long after the original interment to allow of the entire decay of the body, and the skeleton appears to have been broken up in the

removal. Fragments of what appeared to have been a small wooden staff were found, and some remains of iron which may, perhaps, have formed a ferrule at one end. This may have been a sceptre, or staff of authority, buried with the king, and a carved ivory head of an animal, which was also found among the objects in the tomb, may possibly have formed the head. Some pieces of cloth, embroidered with gold, scattered about, had, no doubt, formed part of the robe, or cloak, in which the King's body was laid in the coffin. There were also fragments of a reddish cloth, in texture resembling the basis of velvet. Among the fragments was also found a turquoise, which had apparently been set in a ring. Many fragments of lead scattered about, appeared to show that the corpse had been wrapped in that metal. The result of this examination seems to leave no room for doubting that the bones of King William Rufus still remain in the sarcophagus in which they were originally deposited.

Considerable interest has been recently excited by an important question arising out of the visit of the Archæological Association to examine the WINDOWS OF FAIRFORD CHURCH in Gloucestershire. Mr. H. F. Holt, a member of the Archæological Association, and one of the visitors on that occasion, has adduced arguments of considerable weight to show that the designs of these remarkable specimens of painted glass are the work of Albert Durer. Others have taken a contrary view, and a rather warm controversy has arisen, which is still *sub judice*. We intend to return to the subject on a future occasion.

Mr. Ecroyd Smith has recently published what he anticipates will be his last report (we hope not) on the ARCHÆOLOGY OF THE MERSEY DISTRICT. It includes all the antiquities found in this district during the year 1867. The most interesting of these are the continual accumulation of antiquities thrown up by the sea upon the Cheshire shore. During the year 1867, no less than nine hundred and six objects of archæological interest, entirely exclusive of animal remains, were found on or near the sea-beach of Cheshire. Among them were an arrow-head of bone, and nine stone implements. Of the Roman period there were forty-five different objects, including a silver denarius of the Emperor Geta, two first brass of Nero and Victorinus, and several fine fibulæ and other personal ornaments. Among the relics of the Anglo-Saxon period, by far the most important are three Anglo-Saxon coins. No other Anglo-Saxon coins are known to have been found in this neighbourhood, with the exception of a small deposit at Harkirke, near Formby, to the north of Liverpool, and several interesting historical questions arise out of them, some of which are treated of in Mr. Ecroyd Smith's pamphlet. The first of these coins is a silver sceatta, which is now generally ascribed to Ethelred, king of Mercia, A.D. 675. The sceattas, as is well known, are among the earliest of the Anglo-Saxon coins. The second of these coins is a silver penny of Cnut, in a fragmentary condition, but it bears on the obverse that king's name, and on the reverse an imperfect inscription, from which, how-

ever, we learn that it came from the London Mint. The third coin is a halfpenny, or rather the third of a penny, of the reign of Edward the Confessor, whose name it bears. This small coin of the Anglo-Saxon period, which appears, in fact, to represent the third of a penny, is of very rare occurrence, and the coins of this class have themselves been the subject of discussion. The other objects of the Anglo-Saxon period found on the Cheshire beach, amounting in number to eighteen, are more or less interesting. Among them are some particularly curious beads. The mediæval antiqnities of this collection are extremely varied, and we cannot here attempt to enumerate them. They include a considerable number of coins of the Anglo-Norman and early English kings.

We have also to record the exceedingly interesting discovery of an ANCIENT BRITISH CEMETERY AT WAVERTREE, in Lancashire. In the excavations for the erection of a house on rising ground in Victoria Park, in the neighbourhood of Wavertree Green, no less than six fine sepulchral urns, of the rude class usually judged to be British, were brought to light. Most of them were placed in an inverted position. From various circumstances observed, these appeared to form part of a regular cemetery, and no doubt others would be found if the excavations were continued. From the remains of bones found in the urns, especially fragments of skulls, jaws, and teeth, it was judged that several of the interments were those of mere children. Among other objects found, were fragments of stone implements, and a flint arrow-head. An account of this discovery has been communicated to the Historic Society of Lancashire by Mr. Ecroyd Smith.

An interesting discovery has been made of an early GERMANIC CEMETERY in the neighbourhood of NIEDERBRUNN in the French department of the Lower Rhine, in the course of the works of the railway there. It presented all the usual characteristics of the Teutonic cemeteries of the pagan period, closely resembling those of our own pagan Anglo-Saxon graves. The bodies had been buried entire, with their feet towards the south-east. At the time this account was given, five graves only had been opened, two of which contained arms, axes, and swords, the national arms of the race, and another contained some articles of toilette in bronze, and some of the beads of a collar in coloured terra-cotta. This appears to have been the grave of a female, and the objects of toilette alluded to, appeared to have been placed in her closed right hand, instead of being left in their places in her dress. With them were found three Roman coins, one large brass and two small, all three entirely defaced, but the two latter each having a hole, by which no doubt they had been suspended to the ornaments of the neck. These interments probably belong to the fifth or sixth century.

A BARROW on the top of Tredimus Hill, near the LAND'S END, Cornwall, was opened at the beginning of September, and found to contain what primeval antiquaries call a kist-vaen, formed of eight stones in layers of

four, covered by a flat stone. Within it was found a fine sepulchral urn, with four handles, and ornamented by a rude chevron pattern. It was filled with burnt human bones. On the removal of the earth, a few flints were found, and "a considerable quantity of ashes lay around a large rock in the centre of the mound, on which it is believed the body was burnt."

T. W.

PROGRESS OF INVENTION.

Preserving Wood.—Mr. Nicholas Charles Szerelmey, whose name is well known as an inventor of processes for the preservation of stone, and the manufacture of artificial stone, and whose inventions were applied some years ago to several courts in the Houses of Parliament, has lately directed his attention to the preservation of wood, and has patented a process which he describes as follows. In order to preserve railway sleepers, and wood generally, from white ants, *Teredo navalis*, dry rot, and decay from any other cause, I dissolve in fifty gallons of boiling water ten pounds of powdered potash and forty pounds of powdered lime; in another one hundred and fifty gallons of cold water I mix forty pounds of sulphuric acid; afterwards I mix the two liquids together: this is compound No. 1. Again, I boil in an iron pot fifty gallons of crude petroleum, forty pounds of asphaltum, and thirty pounds of powdered lime, and after half an hour's boiling, I mix with them one pint of sulphuric acid: this is compound No. 2. I immerse the railway sleepers or timber in the liquid No. 1 for a quarter of an hour, or I coat them with a large tar brush and dry them for a day or two. Afterwards I coat the sleepers or timber with a tar brush well on all sides with the composition No. 2, in a hot state. From the experience which Mr. Szerelmey has had in such matters as the preservation of wood, stone, and iron, one would be led to hope that the present invention, being the result of experience, may prove successful, as the end proposed for attainment is most important, not only for railway sleepers, but for those parts of house construction which are necessarily of wood, and which are placed in situations where they are exposed to decay from damp and other causes.

Split Spikes.—Mr. George W. M'Gill, of Washington, United States, has invented a spike for the better fastening of rails to timber; in fact its application would be most useful wherever great strength is required. It consists of a double-pronged spike, with one prong longer than the other, and pointed so as to penetrate the wood. The second prong, which is firmly connected with the head of the spike, lies close alongside of the longer spike; its point, however, is not sharpened in the same manner, it is simply bevelled off in a direction towards the longer spike,

that is, the side of the shorter spike, which is at the greatest distance from its neighbour, is longer than the other side, which is in contact with it, and the bevelled end seems to form with the side of the longer spike an angle of about 30°. When the spike is driven into the wood it pierces it in the ordinary manner, until the point of the shorter spike arrives at its surface; this, as it enters, owing to the shape of its point, is driven in a direction diverging from that of the long spike, and its course forms a curve, much like that which a nail describes when it meets with any impediment to its progress, and this causes it to hold very firmly, and resist effectually any vibrations which might tend to loosen its hold. By the use of this invention the expenses now necessary to re-drive loosened spikes, and to reset displaced rails and ties, or sleepers, will be reduced very considerably. The liability to accident arising from loosened rails will be to a great extent lessened. When the spike has been withdrawn from the wood it can be fitted for further use by simply bending back the shorter spike into its original position alongside of the longer one.

RAISING WATER.—Herman Schlotter, of Köstritz Reuss, has invented an instrument for raising water or other liquids, which consists of a vertical tube, or of a series of vertical tubes, the lower end of which is always below the level of the water, while the upper end is furnished with an air-tight fitting valve. The vertical tubes are adapted to a vibrating beam, so that a vertical up and down motion may be imparted to them. At every down stroke the water will rise in the tubes and will expel some of the air through the valve at the top. Then, upon the tube being raised, a partial vacuum will be formed, and the water will rush in from below to fill it. This up and down motion is to be repeated until the water flows out at the top, and is discharged into any suitable receptacle.

LITERARY NOTICES.

RELIQUIÆ AQUITANICÆ; Being Contributions to the Archæology and Palæontology of Perigord, and the adjoining Provinces of Southern France. By Edouard Lartet and Henry Christy. Edited by Thomas Rupert Jones, Professor of Geology, etc., Royal Military College, Sandhurst. Part VII.—This part contains a description, by M. Louis Lartet, of the Cave of Cro-Magnon, and of the explorations in which he took part. The rocky cliffs on the banks of the Vezère "consist of the edges of the nearly horizontal strata of cretaceous limestones which the river and the water-courses have deeply cut in excavating their beds." Parallel flutings on these cliffs are ascribed by the writer to atmospheric action on the softer layers, which under the most favourable conditions formed true caves. The cave of Cro-Magnon, of which several illustrations are given in this part, is situated at a considerable height and distance above and from the present river level, and was completely covered up by a *talus*, or heap of

earthy matter resulting from the disintegration of the cliff. In the construction of a railway embankment a large portion of this talus and a large mass of fallen rock were removed, and thus the existence of the cave became known. The contractors, MM. Berton Meyrou and Delmarés, judiciously paused in their work as soon as they came upon wrought flints and fossil remains, and M. Louis Lartet was commissioned by the Minister of Public Instruction, M. Duruy, to make a complete investigation. The cave was formed by the removal of softer matter between layers of hard limestone, and its roof was fractured so as to require support. In digging to make the foundation of a column to sustain it, four beds of black ashes were cut through, and in the lowest a portion of an elephant's tusk was found. The limestone out of which the cave was hollowed abounds with *Rynchonella Vespertillio*, which fixes geological horizon.

The ancient men of Perigord appear to have inhabited the cave at various times, leaving relics behind them, and forming beds of ashes, which were covered up in succession by the accumulating soil. It is supposed that as this filling up rendered the cave less convenient, it was used as a sepulchre, and then abandoned.

The human remains are considered by M. Pruner Bey to be of Mongoloid type, and to resemble the Esthonians. One man must have been possessed of great strength, and been of large stature, and the skull of a woman, with a large gash in it, indicates the murderous relations in which these pre-historic folks lived. The remains of an enormous bear, of a great Cave Lion, of the Reindeer, Spermophile, etc., show the deposit to possess considerable antiquity, and it is supposed that the Cro-Magnon station may be referred to a period immediately preceding that in which the first efforts at artistic ornamentation was made by the ancient Perigordians.

In addition to M. Lartet's account of the cave, the present part concludes with Pruner Bey's remarks upon the human remains, and it is illustrated by engravings of flint and bone implements, and of a number of Atlantic shells, pierced, as is supposed, to form a necklace.

A TREATISE ON OPTICS; or, Light and Sight Theoretically and Practically Treated, with the application to Fine Art and Industrial Pursuits. By C. Nugent, C.E., Ex-Principal of the Commercial, Nautical, and Engineering College, New York. (Virtue and Co.)—This book is not without merit, but its style is frequently awkward, and its author does not appear to have sufficiently studied parts of the subject on which he treats. In his first chapter he tells us "light is an *emanation*, or something which proceeds from bodies," a clumsy and inexact definition. In pages 75 and 76 he takes credit to himself for imaginary discoveries, which he fancies reconcile the conflicting views of Newton, Brewster, and others respecting the nature of the solar spectrum; and he lays claim to establishing Goethe's well-known theory of colours, which he ascribes to "some of the ancient Greeks and Romans," evidently without knowing

anything about the great German's experiments and views. He says that "if we look through a prism with its refracting angle downwards at a window-sash, we shall find that *two* colours will appear under each horizontal sash-bar, and one colour at the upper side of the bar." This statement is not correct, as more than *two* colours under each sash-bar and *one* above are plainly discernible. Still more erroneous is the assertion that the appearance of the colours in the order in which they are seen, depends upon our looking through the prism at an object which presents a contrast of light and shade. Colours will be seen upon the bar in proportion to the quantity of diffused light it reflects; and when there is not enough light on the bar to produce visible colours, a spectrum is seen above and below, the tints of which are not altered by illuminating the bar with white light. At page 89 "a very clear plate of alum" is stated "to be opaque for heat," whereas it transmits, according to Melloini, nine per cent, of the rays from a Locatelli lamp. The fact that bodies are not alike transparent for light and heat is represented as showing that "light and heat, though keeping company, as it were, in the sunbeam, are distinct solar emanations, and not merely different states of one power." Here, again, is a muddle of bad statement, and worse reasoning. It is not in accordance with the probabilities of the case that light does consist of anything properly called an "emanation," and if we assign any definite meaning to the phrase "different states of one power," it is not obvious why the so-called power should not be transmitted by a given body when it was in one state, and not when it was in another. We could easily adduce other instances of carelessness, but these may suffice to show the nature of the book.

NOTES AND MEMORANDA.

Antidote to Mushroom Poison.—M. Poulet states that large doses of alcohol are the best antidote to the poison of the genus Amanita, and he thinks experience may show its efficacy with other poisonous fungi. He also states, that boiling in vinegar or salt does not destroy the poison of dangerous species.

Effect of Lightning.—General Morin communicated to the French Academy an account of the action of lightning, which struck a cottage in the village of Chalton, on the 28th July, 1868; ignited it, and caused a fire which spread to and consumed ten other dwellings. The lightning penetrated a piece of modern furniture, containing a silk purse with twenty five-franc pieces in silver, a twenty franc piece, two ten franc pieces, and six five-franc pieces, in gold. When the fire was over, the gold was found not fused, but slightly soldered together, without apparent alteration. The silver pieces were completely defaced, and strongly soldered together. Silver melts at 800°, and gold at 1050° C.

Variations in Human Myology.—The "Proc. Roy. Soc.," No. 104, contains an account by Mr. John Wood, F.R.C.S., of the variation in human muscles from the

standard description observed at King's College, London. The elaborate details can only interest comparative anatomists, but the general results are of wide import. "The total number of abnormalities in 102 subjects (observed in the three last years) is 981, of which 623 are in the sixty-eight males, and 358 in the thirty-four females. The number found on *both* sides is 623, of which 414 are in the males, and 209 in the females. The number found on the *right* side only is 176, of which 108 was in the males, and 68 in the females. The number found on the *left* side only is 182, of which 101 are in the males, and 81 in the females; making a total of 358 one-sided specimens." The greatest number of abnormalities in a single subject was found in the males—one having 25, of which seventeen were in the arms and five in the legs. The deviations from the normal type correspond with the muscular anatomy of the lower animals, monkeys, carnivores, and rodents.

A Daylight Measurer.—Mr. Roger Wright describes, in "Proc. Roy. Soc.," an instrument for approximately measuring the intensity of total daylight. It consists of a rod of solid metal, with a heavy base to keep it upright. The upper or flat surface of the rod is painted white, with a black spot in the centre. Over the rod slides an opaque tube, blackened inside. The observer draws this tube up until the black spot is lost in the gloom, and the light, as marked by divisions on the rod, gives the intensity of the daylight at the time.

Synthesis of Oxalic Acid.—The Perpetual Secretary of the French Academy announced, on the 5th ult., that he had received a letter from Germany, stating that oxalic acid had been formed synthetically by M. Drechsel, in the laboratory of M. Kolb, who obtained it by the action of carbonic acid on sodium divided by sand, or on an amalgam of potassium, heated to the temperature of boiling mercury. Several grammes were obtained by this process. Liebig had already produced oxalic acid by means of sodium and carbonic oxide. DuJong considered oxalic acid as a hydracid formed by hydrogen and carbonic acid $C^2\ O^4\ H$, the general formula of oxalates being $C^2\ O^4\ M$.

Preservation of Wood.—M. Boucherie reports favourably of preserving wood by displacing the sap with a solution of sulphate of copper. When it is to be guarded against attacks of the teredo, he finds coal products, containing phenic acid, most successful.

A Constant Battery.—M. J. Ney recommends a vessel filled with a solution of sal ammoniac, with sand, when it is required for transportation, in which a plate of amalgamated zinc is to be placed; and secondly, a porous cylinder filled with carbonate of copper, in which a plate of copper is to be plunged. To keep the battery going, it is only needful to add, from time to time, crystals of sal ammoniac. The bicarbonate of copper answers for this purpose, and is a cheap article. The carbonate of copper is insoluble in the solution of sal ammoniac, but when a current is formed, it does dissolve in the hydrochloric acid and in the ammonia: the acid goes to the zinc pole, and the ammonia to the copper one; the carbonate of copper becomes soluble, and its reduction produces a secondary current, having the force of a Daniell element.

Large Meteor.—About a quarter of an hour before midnight, on the 7th of October last, a very remarkable meteor was seen, the brilliancy of which was so great, as to be compared to that of a magnesium light. In size it was many times that of Jupiter, being estimated by one observer to be about a fourth part of the diameter of the Moon. The motion was rapid, the colour very red, and it appeared to leave a slight reddish track behind it. It was seen over at least the south of England, and great part of the north of France. Mr. Glaisher is collecting the accounts of the different observers, in the hope of being able to determine the actual path and distance of the meteor. Owing to the lateness of the hour, these are not very numerous, and Mr. Glaisher will be glad to receive any additional information of an accurate and reliable kind.

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THE FLOATING TUNICATES OF THE ATLANTIC OCEAN.

BY CUTHBERT COLLINGWOOD, M.A., F.L.S., ETC.

(*With a Coloured Plate.*)

WHILE crossing the Atlantic from south to north, in the summer of 1867, it was my good fortune to encounter a remarkable series of calms, which, while they were generally anathematized by the officers and crew of Her Majesty's corvette, in which I was a passenger, as delaying their much longed-for return to English shores, were hailed by me as a most desirable circumstance, since it afforded me good opportunities of becoming acquainted with the vast floating population of the ocean, which seemed to take delight in approaching the glassy surface and swimming about, undisturbed by winds or waves. But one thing marred my satisfaction, and the reader will appreciate it when it is stated that, owing to the anxiety to reach England, whenever the light breeze had fallen and ceased to fill the sails, and the ocean had become gloriously smooth—teeming with curious animals—and the time had come for the naturalist to revel among Hydrozoa, Tunicates, and other marine beauties, orders were at once given to get up steam, and we were soon ploughing through them at the rate of five or six knots an hour; so that whatever was obtained could only be obtained with great difficulty, and for one specimen secured, thousands were passed by.

It was on the 4th of July, in latitude 30½° N., and longitude 36° W., that we first encountered those vast shoals of marine animals, composed principally of the compound Salpæ, to which the present paper will be devoted. Associated with them were beautiful Lucernarian (umbrelliform) and Beröid (ciliograde) Medusæ, of rare forms; but the predominant animal, by far, was the species of Salpa known as *Salpa pinnata,* which appeared under three distinct forms, differing so much from one another, that no one unacquainted with these animals would have dreamed of their close relationship. Two of these were associated forms, and the third a solitary one.

Looking down from the deck of the vessel upon these animals, the deep blue background of the sea materially assisted in rendering them visible; for so transparent is their tunic, that when transferred to a white basin, they become altogether invisible, with the exception of certain coloured structures, which were very evident when seen in the sea. These were, a yellowish-brown canal,

extending nearly through the body, from end to end (the intestine), and two elongated and delicately-tinted spots, of a light pink colour, known as the lateral organs. All these became intensified in tint when some distance below the surface, and the transparent tunic itself, seemed to become more visible the deeper it was immersed, attaining a rich emerald green tint of such brilliance, that it might almost be said to be luminous. But this apparent luminosity was only visible in daylight, and evidently arose from reflection; for I frequently watched at night for any luminous appearances, in vain, though I knew we were passing through shoals of these animals, and those which I kept in my cabin exhibited no luminous phenomena.

By far the most abundant form consisted of individuals variously aggregated in sets of two, three, four, or more, up to eleven or twelve, in which case they assumed a globose form, not unlike the partially-separated carpels of an orange. Not unfrequently single specimens floated alone; but these and the smaller numbers which formed incomplete series were evidently individuals which had been separated from perfect series, and partial chains, which had been broken by accident (see Fig. 1). The perfect chains (for so they may be called, though, being circular, the chain was an endless one) were uniformly and symmetrically globular, and not unfrequently consisted of a double series of individuals, the second series being situated outside the first, but never so numerous as the inner one, consisting usually of from four to six individuals. Probably the outer series is more liable to become detached, and seldom or never seen perfect. They floated by in an oblique position, for the most part, and when watched in calm water, did not appear to possess any very considerable powers of locomotion; for, although they evidently moved, the movement was not nearly so rapid as that caused by the energetic contractions of the umbrella of an Acaleph.

On removing one of these masses or chains from the water, the individuals were easily separated from their attachments. Each one was found to possess a rectangular, gelatinous, flattened pedicle, on the hæmal aspect, and all the pedicles were united by a knife-like edge (Fig. 1); the outer series having pedicles of correspondingly increased length, so that they all united at a common point in the centre. These knife-edges required but slight force to separate them, and the members so detached became free and independent, remaining, however, perfectly lively when isolated, and thus accounting for the single individuals, and for the various mem-

bers constituting the chains. Each individual had a length of about two and a half inches, and a diameter of one inch and one-eighth; and every member of the chain was the exact counterpart of its fellow, consisting of a tough bag of transparent gelatinous substance, open at either end, and allowing a current of water to flow freely through. The apertures at either end of the body, though differently constructed, were both continually opening and closing, taking in and ejecting considerable quantities of water, by which strong currents were produced, and by means of which the body was forced slowly along. The anterior aperture, or respiratory mouth, which admitted the water, was of a distinctly valvular character, having a profile greatly resembling the mouth of a fish. The opening and shutting of this mouth was not accomplished by the movement of both lips, but by that of the lower, or inner enclosed one only, which seemed to be the only moveable part of the structure. The posterior aperture, or respiratory anus, was of a more simple form, closing as by a sphincter, and then opening again, alternately.

The most usual result of this injection and ejection of water was to give the whole mass a revolving motion, accompanied also by a slightly progressive movement, the rotatory motion being perhaps the result of the fact, that in a perfect chain, the mouths of the individuals did not all open and shut simultaneously, as though by any consentaneous effort.

This contraction of the body and expulsion of water is accomplished by three complete sets of muscular bands, which are, however, very difficult to be perceived in the transparent coat of the animal. These muscles are attached to the internal of the two coats of which the tunic consists. The external coat or mantle is absolutely structureless, and possesses neither fibres, vessels, nor nerves; and, although certain granules and corpuscles may be detected in it, it is probable that they are the remains of an *original cellular* formation, which may occasionally be observed, though obscurely, in the embryos. The internal mantle is distinctly separated from the outer, and, microscopically, no more can be detected in its proper structure than in that of the external coat; but it is somewhat less transparent and less elastic. The muscles, being attached to it, throw it into folds and rugosites. Canals for the circulating fluid may also be observed in it. Externally, it is closely united to the outer mantle, and internally it is covered with epithelial cells, without nuclei.

These Salpæ are rounded upon the peduncular aspect, while the

opposite side is squarish, owing to a pair of parallel ridges, along which are situated the two beautiful rose-coloured objects, so distinct in the water, and which are known as the lateral bodies, and placed between the first and second muscular bands. The microscopic appearance of these bodies is that of a glandular tube, with numerous lateral diverticula, like a gland without an excretory duct; and their use is unknown. H. Müller looks upon them as kidneys; but Vogt is of opinion that they are simply deposits of pigment, such as are found in other parts of various Salpæ; but these lateral bodies are only found in *Salpa pinnata*.

The finger may be slipped into the tunic of *Salpa pinnata*, and even through it, as into the finger of a glove, and it will feel then, lying loose in the cavity (except where attached above and below), a cord-like body (Fig. 11), which runs somewhat obliquely to the length of the tunic, curving forward below, and is delicately marked with fine transverse striæ. A lens exhibits these to be ciliated, and a microscope reveals broad, spiral bands, covered with rapidly-moving cilia (Fig. 3). The cylindrical suspended body is the branchia, lying in the respiratory cavity. And in the same cavity of this form of *Salpa pinnata*, I frequently observed one or more minute crustaceans of the genus Hyperia, which swam freely about, as voluntary tenants, and seemed perfectly at home. Very few Salpæ were without one of these little companions, which was distinctly visible through the transparent walls of the tunic (Fig. 1).

Running nearly parallel with the branchia, and taking the same direction, is a delicate, narrow, ciliated band; and internal to this is the yellowish-brown canal of the intestine, the coloured structure which alone is visible at a distance, when the animal is seen floating beneath the water. This intestine is simple in form, cylindrical, narrow anteriorly, and widening posteriorly, where it partially overlaps a contractile vesicle (the heart), and extends downwards into a pouch of the tunic, where it ends in a cul-de-sac, which represents the liver, simple in this form of Salpa. The intestine is filled with brownish granules.

Such was the form of Salpa which constituted by far the greater portion of the vast shoals of marine animals through which the ship passed for eleven days. The weather was, for the most part, calm, and they floated at all depths, from the very surface, to such a depth that they were scarcely visible; but even when a stiff breeze had considerably ruffled the surface of the ocean, I could still discern them beneath the waves. During these eleven days we had passed

from lat. 30½° N., to lat. 41½° N.: that is, over eleven degrees of latitude, or nearly eight hundred miles, through the greater part of which they were thickly abundant. Their numbers must have been incalculable. Nor did they only show themselves far out at sea; for when approaching the island of Fayal, in the Azores, they seemed as numerous as anywhere. Could I have indulged in the luxury of a boat during these calms, doubtless I might have been rewarded with many new and rare forms of Hydrozoa which accompanied them; but it was only by a laborious effort of fishing from the chains, that I could succeed in getting any specimens.

The form of Salpa which was next in abundance to that just described, was one which, in many respects, closely resembled it (Fig. 7). This occurred also in chains—in fact, always; for, not only were single independent individuals seldom, if ever, visible, but imperfect chains even appeared to be equally uncommon; nor did I ever observe any chain possessing an outer series. The chains were of the size and form of a small mandarin orange, and consisted of a varying number of individuals, ranging between eight or nine, and twelve or thirteen. The gelatinous peduncles which united these were more slender and shapely than those of the larger form, and their union was remarkably symmetrical, so that, looking down upon them, their respiratory mouths formed a very perfect circle, and the radiating peduncles had a regular and beautiful star shape (Fig. 9). I never discovered in the tunic of this form the little crustacean, Hyperia, which I had found so common an inmate of the larger form; and although no one could examine them without regarding them as a young condition of the larger adult form, it was not a little remarkable that I saw no indications of any intermediate condition of size or shape between the two. Vogt considers them as simply the immature chained Salpæ; and, indeed, they are in all respects miniatures of the first described, not only in their compound, but in their individual forms (Fig. 8). All the parts referred to in the adult chained Salpæ were seen in them, and, inasmuch as they were smaller, and possessed of thinner walls, their internal organization was more easily observable. They were more active in their movements also, and the rotatory motion, as well as the progressive one, was easily seen when the chain was placed in a basin of water, in which their more numerous body-lines, by refracting the light, rendered them more distinctly visible.

The heart in these little creatures was an oval, transparent vesicle, partially overlapped by the lower part of the coloured intes-

tine. Its contraction took place about once per second, and at every contraction the transparent fluid which it contained had the appearance of being transferred from the anterior to the posterior part, and *vice versâ*. On the inner side of the ciliated band was a canal, containing granules floating in a clear fluid, which received a jerk at every contraction of the heart, the fluid and granules thus oscillating backwards and forwards, but having, in the main, a movement backwards; while on the outer side of the branchia a similar canal, with like contents, carried them in a forward direction. Below the lateral bodies, and in other parts of the body unoccupied by conspicuous organs, fine canals were visible, ramifying and inosculating freely, and containing oscillating granules. The peduncles also, which are longer in this than in the larger form, contained similar canals. The central nervous ganglion of this species is situated above the lateral bodies, and between them and the anterior attachment of the branchia; and from it five irregular ramifications radiate in all directions, with an undulating tendency; the largest branch passing backward between the lateral bodies.

The simple form of *Salpa pinnata* (Fig. 2) has yet to be described; but, although the chains were floating in myriads, I only succeeded in procuring one individual of the solitary form, nor did I see a second. It was a beautiful organism, bearing a family resemblance to the chained Salpæ, but more symmetrical, having no peduncle. The respiratory mouth was valvular, and the aperture simple. Its general fòrm was flattened, with slightly bellying sides, and its texture transparent and bright as crystal. The lateral bodies at once arrested attention; not a single pair, as in the chains, but five pairs, arranged along the sides of the body, slightly arcuate in form, and of a rich mauve colour. Within the cavity of the tunic it had one of those little Hyperias swimming about which I have observed so commonly in the large chained form. It produced similar currents, and swam freely in either direction, though most usually in that indicated by the arrow.

The internal organization of the solitary form of Salpa was very similar to that of the chained form. There was the branchia, lying like a cord in the respiratory cavity, and the relative positions of the intestine, ciliated band, and heart were the same; but there were also important differences in the structure and arrangements of some organs. The solitary Salpa possesses six pairs of muscular bands, attached to the internal tunic, and disposed between the lateral bodies, which they thus interrupt, as well as above and

below them. At the anterior end of the branchia is a curious organ, called by Vogt the *lacet vibratil,* or vibratile cord (Fig. 6), a convoluted line, which is much more distinct in this than in the chained form.

The intestinal canal is straight and narrow, coloured by its contents, and instead of giving origin to one cul-de-sac at its posterior extremity, there are two small, lobed, cæcal processes, representing the liver. The heart, enclosed in a cartilaginous pericardium, may be distinctly seen regularly pulsating. The central nervous ganglion, situated immediately anterior to the *lacet vibratil,* is of the size of a pin's head, and of a pale, yellowish colour; and a small, horse-shoe shaped spot of a brownish-red colour connected with it, is believed to be an oculiform organ.

But by far the most striking part of the organization of the solitary form of Salpa, was a funnel-shaped body, which commenced at a point near the heart, and, becoming gradually wider, opened out of the body near the *lacet vibratil.* In the anterior and wider part of this funnel, rounded bodies, symmetrically arranged on either side of an axis, grew gradually larger, until they seemed to be thrust out of the open funnel by the growth of those below; and those most advanced were easily separated from the mouth of the funnel.

This remarkable body (Fig. 4) is the proliferous stolon, with its buds. Each bud, as it becomes mature, assumes a more or less top-shaped form (Fig. 5), and the uppermost series becomes discharged, to take upon them an independent existence. In the most mature buds the young Salpæ may be seen moving actively, and the series is destined to give origin to a chain, such as those described in the earlier part of this paper. For this is one of the most singular examples of that alternation of generations which reads so like a fairy tale, and which science received at first on indisputable evidence, although contrary to all experience, and is now beginning to comprehend on philosophical principles. For the solitary Salpa is asexual, and produces, by bud-development, a progeny unlike itself, and united in chains; which also gives birth, by a regular embryonic development, to young unlike itself again, but similar to its parent; and thus, alternately, there are solitary Salpæ and chained Salpæ—isolated asexual individuals, and aggregated sexual chains, in unvarying order. It was Chamisso, who in the year 1819, in a memoir entitled "De Salpâ," announced the startling fact of alternation of generations, having discovered that these creatures really enjoy a double and alternate propagation; and first using

the phrase to express this peculiarity in the multiplication of the Salpæ. And, strange as the assertion appeared at first, it has been fully verified by the observations of succeeding naturalists. Krohn, in 1846, described fully the formation of buds, chains, and embryos in this genus; and subsequently Huxley and Vogt, and H. Müller, of Würtzburg, have left little to be learned, as far as Salpa is regarded. Since then, also, analogous phenomena have been observed in many other tribes of organized beings. And Steenstrup was the first to group all the known cases together, applying to them the term originally proposed in his work, a translation of which appeared among the earlier publications of the Ray Society. In the case of Salpa, with which only we are here concerned, a pile of zöoids bud off from the stolon of the solitary form, which possesses no organs of sex, and are connected with a nucleus at the point of the funnel-shaped body. The first-formed pile of zöoids, when well developed and ready to be extruded, breaks off as a Salpa-chain, while other piles take their place, and in their turn become mature. The united individuals of this chain have no stolon or zöoids, but enjoy a true sexual reproduction, and the development of the embryo, situated posterior to the lateral bodies, results in the birth and extrusion of a solitary or asexual Salpæ.

The genus Salpa, so called from a peculiar trumpet or tube-like fish known to the Greeks, was first established by Forskal on eleven species found by him in the Mediterranean, some of which have been identified, while others have been lost. But Forskal was no anatomist, and it was Cuvier who first properly described their anatomy, and pointed out their true zoological relations. He dissected our *Salpa pinnata*, but erred in supposing that the testicle of the chained form (lying between the intestine and the branchia) was the liver, and that the lateral bodies were ovaries. But the true interpretation of all these organs was not learned by one observer. Chamisso pointed out the alternation of their generations; Milne Edwards first described their nervous system; Krohn discovered the nature and existence of their sexual organs, and published an account of their development and reproduction; and at the same time Professor Huxley was working independently upon the same subject, and gave, somewhat later, in the "Philosophical Transactions," an account made from personal observation, and singularly corroborative of that of Krohn.

The genus Salpa is defined as "swimming tunicates, having two openings, respiratory and opposite, a cylindrical branchia suspended obliquely in the respiratory cavity, with alternate

generations, producing by turn sexual aggregated individuals, and asexual solitary ones." The species described in the present paper is the *Salpa pinnata* of Forskal (synonymous with *S. cristata*, Cuvier).—"Free, gelatinous, oblong body, open at the two ends, and empty; intestine oblique." This species has been fully and elaborately described by Professor Carl Vogt, in the Proceedings of the "Institut National Genevois" for 1854, with numerous and careful drawings—"Sur les Tuniciers de la mer de Nice."

Vogt found *Salpa pinnata* in abundance in the bay of Villefranche, assuming all the forms above described. But it is curious that although I found the species so abundant in the Atlantic, above the latitude of the Straits of Gibraltar, during the month of July, he affirms that he never found it in the Bay of Villefranche from May to September. It began to show itself there at the end of the latter month, and increased until December. The Mediterranean abounds with these and similar animals. Not only were all Forskal's species found there, but when Cuvier asked Péron, who was bound, with Lesueur, on a voyage round the world, to bring him home some Salpæ, he naturally complained that Péron only brought six species, whereas ten species might be found in the French bay of Villefranche alone.

On one occasion, when the sea was dead calm, and I was watching the floating tunicates and Hydrozoa, through which the ship scarcely moved, my attention was arrested by a magnificent object, hovering at some distance below the surface (Fig. 10). It had the appearance of a long, convoluted, and delicate chain of gems, of the most brilliant colours, which waved gaacefully in the currents of the water. It might be compared to a necklace of diamonds, set with brilliant rubies; and although not the organism to which the name of *Cestum Veneris* has been given, it might have been the jewelled girdle of Venus, falling from her as she rose from the sea. Not far from it was another object of, if possible, even greater beauty, consisting of five or six large Salpiform bodies, arranged in an oblique line, each of a bright and delicate emerald-green colour, clear as crystal, and possessing a large, rich ruby spot, which shone in the water like a row of magnificent carbuncles. Even had I been in a boat, I could scarcely have secured them; but I made at once an accurate sketch of their appearance in the water, the truth of which I was enabled to verify a few days later; for I again saw, under similar circumstances, two objects, having identically the same appearance, and, by a most curious coincidence, again both in the field at the same moment. They remained under

my eyes for some minutes, and I succeeded in getting a boat lowered; but it was more difficult to see them from a boat than from the ship's chains, and they could not be secured, although another remarkable object rewarded the attempt. There can be no doubt, however, that these exquisite objects were chains of Salpæ, of a character unknown to the scientific naturalist, though they may often have charmed the eyes of the becalmed sailor; and they well illustrate the unknown riches and the infinite variety of the creatures which lie concealed in the impenetrable depths of the inscrutable ocean.

EXPLANATION OF THE PLATE.

Fig. 1.—Group of two attached *Salpæ pinnatæ*, aggregated form, showing the mode of attachment. A Hyperia in the cavity of the left-hand individual. (One-third natural size.)

Fig. 2.—Simple asexual form of *Salpa pinnata*. The arrows at the openings show the ingress and egress of water. The arrow at the sides, the usual direction of progression. (One-third natural size.)

Fig. 3.—The ciliated cylinder or branchia of the compound Salpa. (Magnified quarter of an inch.)

Fig. 4.—The proliferous stolon and buds of the simple asexual Salpa. (Magnified half an inch.)

Fig. 5.—The same (magnified quarter of an inch), showing the trochiform character of the buds.

Fig. 6.—The *lacet vibratil* of the simple Salpa. (Magnified half an inch.)

Fig. 7.—Complete group of twelve aggregated *Salpæ pinnatæ*, young. (Natural size.)

Fig. 8.—A single individual of the same. (Twice natural size.)

Fig. 9.—The same group, seen from above, exhibiting their symmetrical attachment.

Fig. 11.—The ciliated cylinder (branchia) of simple Salpa. (Half-inch.)

Fig. 10.—A remarkable group of chained Salpæ, observed on two occasions in the Atlantic, in lat. 32° N., long. 35° W.

SANCTUARY AND BENEFICIUM CLERICALE.

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At a time when nearly every civilized nation has established extradition treaties with its neighbours, so that it is almost impossible for great criminals to find safety in flight, it is both interesting and instructive to take a glance backwards at the periods during which such treaties did not exist, and when there was also provided in the institutions of sanctuary and *beneficium clericale*, a refuge for the criminal even on the scene of his crime. No small mental effort is needed to picture the society among which the privilege of sanctuary was allowed. The institution is so foreign to all our own experience, has left so little trace of its existence upon our legal and social system, is so thoroughly a part of the old order which hath changed, "giving place to new," that we read of it with an unsympathetic eye, and listen to accounts of it with a somewhat dull ear. It is in truth hard to realize. Men, manners, circumstances, all things must have been so different from the same things as we know them now; religion, politics, the principles and springs of human actions must have been clothed in such a different dress, that we can scarcely recognize them for the same kinds of motors which influence us at the present day. Yet it is not more than two hundred and fifty years since the privilege of sanctuary was abolished, and not more than forty years since benefit of clergy was taken away in England.

It will be convenient to treat the history of the two institutions separately, as they are, though correlative, distinct. They drew their origin from a common source, but they are not twins, the privilege of sanctuary being the elder child by some hundreds of years. The origin of both is to be found in the veneration that was paid to those things which were included within what was called "the peace of God." These things comprehended in later times not only the altar, but those who lived by it, and at the same period a wider signification was given to the privilege of sanctuary, which was made to cover churches, churchyards, and even, in some cases, land that was merely owned by churchmen, but appropriated to secular uses.

There is, perhaps, a natural feeling of respect and veneration for a building devoted to the service of God, which would be shocked and alarmed at the prospect of violence offered to any one within it,

and this feeling would probably arise in the breast of any one, whether in a Christian church, a Jewish temple, or a Mohammedan mosque. So to disregard the existence of Him whose house the building was said to be, and who was supposed to be more perceptibly present there than anywhere else, as to kill or in any other way to injure one's neighbour in it, seems to have been at an early period regarded as a monstrosity, and an offence offered directly to the Most High. There is something beautiful in the idea that even among rough, rude men, accustomed to violence, and at home amidst scenes of strife, there should yet be a sentiment of respect for certain places, so strong, that on entering them the fiercest passions disarmed themselves, the deadliest feuds were suspended, and vengeance permitted her uplifted hand to fall harmlessly to her side. It is something admirable that there should have been some place of shelter where the fugitive and the weak might be at peace, and where, on this side the grave, the wicked ceased from troubling and the weary were at rest. Besides this negative form of protection which sanctuary afforded, bidding the violent not to touch her anointed and to do her children no harm, there was in the institution a nursery and a home for moral indignation which thence could speak boldly and warmly without fear to the highest and powerfullest oppressor, and bid him, by all his religious hopes, by all his superstitious fears, "cease to do evil," even if he would not "learn to do well." Thus, it was by virtue of that right, which even bad men recognize, of disinterested virtue, to speak as it were *ab alto*, the right which had its home in sanctuary places and the like, that St. Ambrose, blocking up the way into Milan Cathedral, forbad the Emperor Theodosius to pollute the church with his presence till he had atoned for the blood which stained him by penitence and prayer. And it was out of a natural fear and respect that the emperor obeyed the voice of the priest speaking in the name of Divine Right. In addition to this natural aversion from violating sacred places, there was for the Jews a positive commandment on the subject, which had its effect, and a very great one, on the political and social system of that people. Among the earliest laws given by Moses were some which established the principle of sanctuary on a clear and intelligible basis, and imposed upon the people the observance of its privileges in the strictest manner. In the same chapter of the book of Exodus in which he laid down the solemn law, "He that smiteth a man so that he die, shall be surely put to death," he said; "and if a man lie not in wait, but God deliver him into his hand, then I will appoint thee a place whither he shall flee. But if a man come

presumptuously upon his neighbour to slay him with guile, thou shalt take him from mine altar that he may die." The same instructions are given in different form in other places in the Pentateuch, but the above quotations from the twenty-first chapter of Exodus, contain all the principle of the law of sanctuary as intended by Moses. Details of practice he gives elsewhere.

It is clear that the object Moses had in view when he appointed the cities of refuge, was to prevent the hasty and revengeful killing of a man who had had the mishap to slay another by accident. Over murderers, that is slayers with malice aforethought, he threw no protection, they might be dragged even from the altar, and were to "be surely put to death." Why, if the principle of protecting those who were only guilty of what we call manslaughter, was in itself fair and equitable, it should not have been sanctioned in all the Jewish cities, so that under no circumstances it should be permissible to kill such persons; and why, given the cities of refuge, there should have been such conditions imposed on those who fled to them, as to make them feel perpetually that they were in a sort of large prison, it were hard to say. Perhaps the intention was by making the protection a difficult matter, a matter of exertion, anxiety, and expense, to compel the people to be as careful as possible not to kill each other, even by misadventure. It was a sort of homage paid to the sacredness of human life. There is no trace of sanctuary in the modern acceptation of the word attaching to the Jewish tabernacles, or even to the permanent Temple at Jerusalem. It was, perhaps, thought that no one would dare to violate their precincts. In the appointed cities of refuge only an asylum could be found as a matter of law and political religion, and even there certain formalities had to be gone through as a condition precedent of the grant of protection. "At the entering of the gate of the city," the fugitive manslayer was bound to "declare his cause in the ears of the elders of that city," and they, on hearing the declaration were bound to try the man according to the law of Moses, to see if he were guilty of murder or of manslaughter. The "avenger of blood" was the prosecutor, and "the congregation," by which we may reasonably understand a jury, were the triers. If the case were made out to the satisfaction of "the congregation" to be one of murder, the "elders of that city" were bound to surrender the fugitive, even though he clung to the horns of the altar, and he was surrendered, whether to public justice, or to the private malice of the friends of the slain, does not clearly appear, though the injunction "he shall surely be put to death," would seem to be laid rather

on the public magistrates than on the relations of the murdered. If the case proved to be one of manslaughter only, the killer was received into the protection of the city of refuge, out of which he might not go, except at his own peril, and there he was to remain till the death of the then high-priest, on which occasion the public grief was supposed to swallow up all private resentments, and fugitives were free to go back to their homes. It will be observed that among the Jews, sanctuary existed only for manslayers, not for any one who chose to claim it.

In Greece there were some twenty sanctuaries where the fugitive might find shelter, and in Pagan Rome the Temples of the Gods afforded an equal protection. On the conversion of Constantine to the Christian faith, the privilege of sanctuary was transferred from the temples to the churches, and the piety of Theodosius the younger extended it to consecrated ground. So great a respect did even enemies pay to the right that when Alaric captured Rome in A.D. 410, he ordered that the churches of the apostles, Peter and Paul, should be respected as inviolable sanctuaries.

The right to protection which was, so to speak, local among the Jews, was personal among the northern pagans, who overthrew the Western Empire. With them there was always a right, independent of place, ready to spring up on payment of the composition, hush-money, or *wehrgeld,* of which the amount was regulated by law. The amount varied according to the rank of the slain, and was paid over to his friends, or in the case of a slave, to the slave's master. The composition for murder was fixed by the Anglo-Saxon laws at the time of the Heptarchy at twelve hundred shillings for a King's thane, and six hundred for a thane of the second degree. Ceorls, or the lesser freeholders, were valued at two hundred shillings, and slaves at somewhat less than a fourth of that sum.

The progress of Christianity among the rough northmen caused the return to a more bloody satisfaction, or rather, the value of human life came to be regarded as too high to be compensated by a mere money payment, and men turned to the Mosaic law, which demanded blood for blood, for their guide, and capital punishment once more became the order of the day. At the same time the Mosaic law of sanctuary was engrafted on the Christian code, and modified so as to embrace, not only certain places of a special name, but all places of a special class. The measure of protection afforded by sanctuary was also very much extended.

Soon after the conversion of the Saxons to Christianity, all their places of public worship came to be looked on as so sacred

that any criminal fleeing to them was safe. "The peace of God" covered the very worst offenders. No man might presume to touch those whom the Church, heaven's representative, did not cast out. Fugitives were allowed to stay in the church for thirty days, finding their own food, and at the end of that time they were handed over to their friends unhurt.

In England, where sanctuary came in with Christianity, a modification of the rules of admission to the privilege was early introduced. The weak and the oppressed, the innocent, who fled from open and apparent violence were received immediately and without question; but criminals had, like the Jewish man-slayers, to declare their "cause in the ears of the elders," or rather they had, on coming to the church or monastery, to confess that they had committed felony, and that they came because their life was in danger. Unless they complied with these rules they were liable to be dragged out of the sanctuary, and to be punished according to law. If they did comply, the Church was bound to protect them against all comers, but not to find them sustenance, for forty days. Within that time, however, the criminals were obliged to confess more particularly before the coroner, the nature of the offence which they had stated generally on entering to have been a felony. On hearing the confession, the coroner administered an oath of abjuration to the sanctuary man, who swore to go with all speed to a port named by the coroner, carrying a cross in his hand, and to embark for a foreign land, whence he was not to return without the King's leave, under pain of losing all his privilege. While he remained in the sanctuary, and while he was on his road to the coast, protection was given to him, and anyone killing him was punished as a murderer. The man's blood, however, was attainted, and all his property was forfeited to the Crown.*

Besides the general privilege of sanctuary which accrued to all churches and consecrated places, there were special privileges superadded to certain places, which made them asylums for every crime under the sun. For common sanctuary, though it covered a mul-

* Mr. Hallam ("Middle Ages," vol. iii., p. 303), gives the following instance of the light in which sanctuary privileges were regarded, at least in France:—"A son of Chilperic, King of France, having fled to the sanctuary of Tours, his father threatened to ravage all the lands of the church unless they gave him up. Gregory, the historian, bishop of the city, replied in the name of his clergy that Christians could not be guilty of an act unheard of among Pagans. The King was as good as his word, and did not spare the estate of the church, but dared not infringe its privileges. He had, indeed, previously addressed a letter to St. Martin, which was laid on his tomb in the church, requesting permission to take away his son by force, *but the honest saint returned no answer*."

titude of sins, did not in this country protect high traitors, or those who had been guilty of sacrilege. Murder, robbery, rape, arson, almost every kind of wickedness was screened by it, but these two crimes were deemed to be too heinous to be included in "the peace of God," unless by special charter. There were not many places which possessed this right. Westminster Abbey was one of them, and in the charter given to it by two of the Saxon kings, and in one by Edward the Confessor, confirmed by William the Conqueror, the largeness of its privilege is duly set forth. The privilege attached to the institution, and not, at that time, to the place only, so that though the Abbey Church and buildings were renewed once and again, the privilege granted to the original fabric was passed on in its integrity. The following charter, given by Edward the Confessor, is instructive in respect both of style and matter:—

"Edward, by the grace of God, king of Englishmen: I make it to be known to all generations of the world after me, that by special commandment of our holy father, Pope Leo, I have renewed and honoured the holy church of the blessed apostle, St. Peter, of Westminster; and I order and establish for ever, that what person, of what condition or estate soever he be, from whence soever he come, or for what offence or cause it be, either for his refuge into the said holy place, he be assured of his life, liberty, and limbs. And over this *I forbid, under the pain of everlasting damnation,* that no minister of mine, or of my successors, intermeddle them with any the goods, lands, or possessions of the said persons taking the said sanctuary; for I have taken their goods and livelihood into my special protection, and therefore I grant to every each of them, in as much as my terrestrial power may suffice, all manner freedom of joyous liberty; *and whosoever presumes or doth contrary to this my grant, I will he lose his name, worship, dignity, and power, and that with the great traitor Judas that betrayed our Saviour he be in the everlasting fire of hell, and I will and ordain that this my grant endure as long as there remaineth in England either love or dread of Christian name.*"

There were other special privileges attaching to chartered Sanctuaries besides those of protecting persons guilty of high treason and sacrilege. Instead of being obliged to abjure the realm within forty days, felons coming thither might remain for life, though if they chose to abjure, and so discharge all their offences to date, they were free to do so, in which case they were bound to follow the ordinary course of procedure. There were not many of these chartered Sanctuaries in England. Added to the numerous asylums

already in existence, affording the ordinary privileges of sanctuary, the social and political state of things at home would have been simply unbearable. As it was, licence went all uncurbed, and the increase of chartered places would have been but an increase of mischief. The chief provincial chartered Sanctuaries were at York, Manchester, Wells, Norwich, Lancaster, and Northampton. In London, St. Martin's-le-Grand—where the General Post Office now stands—had privileges almost equal to those enjoyed by Westminster. The college, consisting of a dean and secular canons, was founded by Ingelricus and Edwardus, two brothers, in the year 1056, and William the Conqueror, in 1068, confirmed the foundation, and gave a charter of his own "to the canons, serving God day and night." In the course of time, laymen, and laymen of a very indifferent sort, came to be residents by tenancy within the Sanctuary precincts, and the dean and canons, more jealous of the privileges of their college than of the true honour of the Church and the interests of good order, threw their shield over scoundrels whom it would have been an act of justice to the orderly and well-disposed to hand over to the officers of the law. In the year 1442, "as appeareth in a book, written by a notary of that house" (St. Martin's) a soldier who was a prisoner in Newgate, was being led to the Guildhall, probably for examination before the magistrate, when five of his companions rescued him from the charge of the officer, and "brought him into sanctuary at the west door of St. Martin's Church, and took grithe" (claimed protection) "of that place." The sheriffs of London, hearing of the affair, came the same day, forcibly entered the church, and dragged the rescued prisoner and his five friends out, chained them, and took them to Newgate. The dean and chapter complained bitterly to the king (Henry VI.), "all which complaint and suit the citizens, by their counsel, Markham, serjeant at the law, John Carpenter, late common clerk of the City, and other, learnedly answered, offering to prove that the said place of St. Martin had no such immunity or liberty as was pretended; namely, Carpenter offered to lose his livelihood if that church had more immunity than the least church in London." The case was fully argued before the king and council in the Star Chamber, and thereafter, the prisoners having been brought before the chancellor on a writ of *habeas corpus* (the common law writ) were remitted by the judgment of the council to "Saint Martin's, there to abide freely as in a place having franchises," as long as they liked. In 1548 the college was surrendered to Edward VI., but the privileges of sanctuary seemed to have

been considered as inherent in the place, and Stowe complains that persons for whom the right was not intended enjoyed it, observing that the right was granted to the canons serving God day and night, "which may hardly be wrested to artificers, buyers, and sellers, otherwise than is mentioned in the twenty-first of St. Matthew's Gospel."

There are several memorable instances of the violation of sanctuary at Westminster. The first and most remarkable, to judge from what Walsingham says of it, took place in August, 1378. The good monk begins his account with bewailing his sad fate at having to chronicle how certain "satellites of Satan, forcing their way into the temple, perpetrated the unheard-of act of wickedness, viz., the pollution of that church of God, dedicated to the Prince of the Apostles, which hitherto had been undefiled even by unbelievers and faithless enemies." He goes on to say that, "but our time came when men bearing the Christian name proved themselves to be worse than infidels." It seems that two esquires, Robert Haule and John Schakel, had, in the Black Prince's war in Spain, captured the Count de Dines. The count, after pledging his word of honour, and giving his eldest son as a hostage for his ransom, went back to Spain, and broke his faith. Interest was made through the Duke of Lancaster (John of Gaunt) for the release of the son, and the esquires refusing to give him up, a quarrel ensued, and the duke being all powerful, threw Haule and Schakel into the Tower. From this prison they escaped, and fled to Westminster, where they took grithe, or claimed sanctuary. The Duke of Lancaster, hearing of this, ordered the fugitives to be taken from the Sanctuary, and remitted to the Tower of London. John Schakel was accordingly seized and reconveyed to prison, but Robert Haule, resisting, was hunted round the church, and in spite of a vigorous attempt to defend himself, and in spite of the intercession of the priests, was slain by the altar on the eve of St. Laurence. One of the servants of the church was also killed in the scuffle, which, according to Walsingham, was of the most disgraceful kind. The Archbishop of Canterbury solemnly excommunicated the malefactors concerned, especially Sir Alan Buxhulle and Sir Ralph Ferrers, and the Bishop of London published the sentence in St. Paul's Cathedral. The Duke of Lancaster took umbrage at this, and questioned the righ of Westminster Abbey to afford sanctuary, but the abbot brought the matter strongly before the next Parliament, which confirmed what was already an undoubted right by royal charter.

At a much earlier date (A.D. 1262) the Abbot of Westminster

endeavoured to get the right which appertained to the church and college extended to all lands and buildings anywhere, belonging to the abbey. The question arose upon the action of the sheriffs of Middlesex, who had executed warrants within some of the abbey lands. The Court of Exchequer decided that the sheriffs might enter the city of Westminster, up to the gates of the abbey, and execute their warrants, and that the precincts of the abbey only were privileged, not the outlying possessions of it. At the same period, the abbot tried, unsuccessfully, to get the privilege of sanctuary enlarged, so as to cover debtors and offenders under the degree of felon. Sanctuaries were, however, later on, made asylums for debtors in this way. It was averred that imprisonment, which was the punishment for debt, was likely to endanger life. Sanctuary, undoubtedly, covered all, no matter whom, who fled for their lives, so that debtors flying to the Sanctuary might be said to come *in periculo vitæ*, and therefore to be entitled to protection.

Speed gives a very full and very interesting account of the debate at the Council Board, upon the question whether Queen Elizabeth, Edward the Fourth's widow, who had fled to Westminster with the Duke of York, might not be taken out of sanctuary. There was no manifest violence threatened to her or her son, neither of them had committed any felony, and the privilege of sanctuary was held to cover only such persons as were in evident danger of their lives, or who, having committed felony, would be in danger of them if they remained open to the law. The Protector was above all things desirous to get the Duke of York into his hands, and declared, at the council, that it was a direct insult to the nobility on the queen's part, thus to hide herself, and to seclude the young prince from those recreations and amusements which his age required, and he proposed to send the Archbishop of York to move the queen to give up the boy, proposing also, in the event of her refusal, which he seems to have expected, to take the duke away by force. The archbishop was the next to speak, and while agreeing with the Duke of Gloucester that it was expedient the young prince should be with the king his brother, rather than be cooped up in sanctuary, deprecated in the most emphatic way all attempts to violate the place of refuge—"for it would be a thing that should turn to the great grudge of all men, and high displeasure of God, if the privilege of that holy place should now be broken, which had so many years been kept, which both kings and popes so good had granted, so many had confirmed, and which holy ground was, more than five hundred years ago, by St. Peter, in his own person, in spirit accom-

panied with great multitude of angels, by night so specially hallowed and dedicated to God (for the proof thereof they have yet in the abbey St. Peter's cope to show) that from that time hitherward, was there never so undevout a king that durst violate that sacred place, or so holy a bishop that durst presume to consecrate it." The Duke of Buckingham, in speaking of the question, said—" And yet will I break no sanctuary therefore, for verily sith the privileges of that place, and other like have been long continued, I am not he that will go about to break them. And in good faith, if they were now to begin, I would not be he that should be about to make them."

The following extract from the duke's speech, as reported by Speed, is almost eloquent; and, as it serves so well to show the abuses which, even at that date, Sanctuaries had become, it is given whole:—

"But as for thieves, of which these places be full, and which never fall from the craft after they once fall thereunto, it is pity the sanctuary should serve them, and much more man-quellers, whom God bade to take from the altar and kill them, if their murder were wilful. And where it is otherwise, then need we not the Sanctuaries that God appointed in the old law; for if either necessity, his own defence, or misfortune, draweth him to that deed, a pardon serveth which either the law granteth of course, or the King of pity may. Then look we now how few sanctuary men there be whom any favourable necessity compelled to go thither; and then see on the other side what a sort there be commonly therein of them whom wilful unthriftiness hath brought to nought; what rabble of thieves, murderers, and malicious, heinous traitors, and that in two places especially—the one at the elbow of the City, the other in the very bowels. I dare well avow it, weigh the good that they do with the hurt that cometh of them, and ye shall find it much better to lack both than to have both. And this I say, although they were not abused as they now be, and so long have been, that I fear me ever they will be while men be afraid to set the hands to amend them, as though God and St. Peter were the patrons of ungracious living. Now unthrifts riot, and run in debt, upon the boldness of these places; yea, and rich men run thither with poor men's goods. There they build, there they spend, and bid their creditors go whistle. Men's wives run thither with their husband's plate, and say they dare not abide with their husbands for beating. Thieves bring thither their stolen goods, and live therein riotously; there they devise new robberies. Nightly they steal out; they rob and

rive, kill and come in again, as though these places gave them not only a safeguard for the harm they have done, but a licence also to do more. Howbeit much of this mischief, if wise men would set their hands to it, might be amended, with great thanks of God, and no breach of the privilege."

In addition to the Sanctuaries at Westminster and St. Martin's-le-Grand, there was the privileged Convent of the Whitefriars, founded by Sir Patrick Grey in 1241. This fraternity received a grant of land from Edward I., and their property stood on the ground comprehended between what is now Salisbury Street and the Temple on one side, and Fleet Street and the Thames on the other. The place was better known in later days, after the privilege of sanctuary had been abolished, under the name of Alsatia.

It appears very clearly, from the Duke of Buckingham's speech quoted above, what sort of persons they were who used sanctuary in his day. The nuisance increased as time went on, and Henry VIII., early in his reign, determined to put a check upon it. His Privy Council agreed that it could never have been intended sanctuary should be a place where men might plan fresh crimes, and come back in safety after having committed them. Wolsey tried a compromise, and ordered that sanctuary men should take an oath not to commit crimes *sub spe redeundi*. An oath was not likely to hold men who were already foresworn a dozen times over. The nuisance increased, and in the 21st of Henry VIII. an Act passed the Parliament and the King, which ordered murderers and felons in sanctuary who ought to abjure to be branded on the thumb with an A; and those who ought to abjure, and would not, were to be taken out of sanctuary, and proceeded against according to law. Shortly after this Act passed, complaint was made that through its operation too many skilled artizans were compelled to expatriate themselves; and it was ordered that in future sanctuary persons should be burned in the hand, and abide in some place appointed by the coroner. If they came out of this appointed place, they were to suffer death as abjured persons coming back without leave. In the twenty-seventh year of Henry's reign sancuary men were ordered to wear badges, were forbidden to carry arms, or to be abroad in the Sanctuary before sunrise or after sunset. Then privilege of sanctuary was taken away from murderers, burglars, highwaymen, housebreakers, and persons guilty of rape or of arson. Governors were also appointed over the Sanctuaries, and the refugees had to answer a daily roll call.

It was not till 21 Jac. I., c. 28, that sanctuary privileges were

wholly taken away, and every man became responsible to the law for what he had done, no matter to what asylum he had withdrawn himself. But legal sanctuary being abolished did not therefore take away the right of certain people to congregate in certain places, and the old Sanctuaries, long after their privileges had departed, were the homes of the criminal and the dissolute—places in which no sheriff dared to go without a military escort, and in which, under ordinary circumstances, no warrant could be executed. The Sanctuary at Westminster was pulled down in 1775, and the ground it occupied is now the site of the Westminster Hospital. The Post-Office represents St. Martin's-le-Grand; and other rookeries, such as Alsatia, the Savoy, and the Mint, have also given place, under the mania for street improvements, to wholesome buildings and sightly streets, and to inhabitants at once useful to the commonwealth and a credit to themselves.

Of kin to this privilege of sanctuary was the *beneficium clericale*, or Benefit of Clergy, which was a personal, while the other was a local immunity. So far as England is concerned, it is not too much to say, that if Henry the Second's over-zealous knights had not committed the blunder, as well as the crime, of pushing their swords into the breast of Thomas à Becket, benefit of clergy would have been for ever crushed out. But the blood of that "martyr" was the seed of the Church's prerogative to suffer to go unpunished all such of her own clergy as committed offences against the law. The Constitutions of Clarendon, which provided for the abridgment, and in most cases for the abolition, of the right of the clergy to be tried before the spiritual courts only, even for offences against the criminal law, were abrogated by the veto of the Pope, which the King, overwhelmed with confusion and obloquy at the violent death of à Becket, had neither the power nor the courage to resist. Thereafter, the benefit of clergy grew to be a yet more unwholesome plant than it had been, protecting under its shade not only the actual clergy themselves, but also laymen who possessed the qualifications by which the clergy proved their degree, viz., the power to read or write.

The basis on which benefit of clergy rested was no doubt the supposition that "the servants of the servants of God" *could* not possibly commit any crime, notwithstanding the precedents made by the sons of Eleazer and by the sons of Eli. The claim early preferred by the clergy was willingly allowed by the laity, who held in special veneration the priests of that sacrifice which they so little understood, and which they deemed to be so saving. Clerks accused

of crime before a secular judge had but to plead their rank, or to sue out a sort of *habeas corpus* from the ordinary, and forthwith they were handed over to the spiritual court, where they might be punished by ecclesiastical censures, or imprisonment, and sometimes, in flagrant cases, by degradation. But the more customary course was for the ordinary to put the accused to his "purgation," a process which involved a serious and most dangerous temptation to commit perjury. The accused was made to swear that he had not done that of which he was accused; and he had to bring a certain number of other persons who swore that they believed him. So that, upon evidence less satisfactory than that of the four witnesses who swore they did not see the prisoner steal a coat, in opposition to four witnesses who swore they did see him steal it, the worst offenders were often suffered to go at large, simply because they could claim their "clergy;" other men not so guilty, but unable to claim the privilege, being at the same time punished most rigorously by the laws of the land.

Benefit of clergy extended to all capital felonies, and, till Henry VIII., might be claimed any number of times. The solemn farce of purgation soon fell into desuetude, and the ordinaries found imprisonment too expensive an entertainment when they were called upon to provide it as part of the sentence on all who claimed clergy. For veritable clerks they were willing to set penances, and they did, as a matter of discipline, occasionally imprison them; but the lay scoundrels, who were turned over to them simply because they had proved their clergy by being able to read or write a line or two, were both too many and too incorrigible to get their deserts at the bishops' hands. The judges of the spiritual courts, therefore, soon got into the way of following the advice of Dogberry to the watch: "The most peaceable way for you, if you do take a thief, is to let him show himself what he is, and steal out of your company." So the worst offenders got off practically scot-free; if they could read or write they had benefit of clergy; if they could not, they fled to a sanctuary, and there remained under the wing of Holy Church.

This abuse of the privilege attracted the notice of the English Justinian, Edward I., who passed an Act that no clerks delivered to the ordinary should go free without being put to their purgation, "so that the king shall not need to provide any other remedy therein;" and a statute of Edward III., confirming the benefit of clergy as an institution, recites a promise by the Archbishop of Canterbury that he would take care punishment was administered to offending clerks, 'so that no clerk shall take courage to offend for de-

fault of correction.' The promise was not kept, the nuisance increased, and during the long struggle of the houses of York and Lancaster, men's minds were too much occupied with the one absorbing subject to remedy the wrong which they yet noted. Henry VII. passed a law by which persons claiming clergy, but not in orders, were restricted to one allowance of the privilege, and even then they were to be branded in the hand in open court with the letter M, if they were murderers, F, if they were felons of less degree, before they were handed over to the ordinary. Henry VIII. took away the privilege from all persons, not actual clerks, who had committed murder, and from certain felons who "bear them bold of their clergy, and live in manner without fear or dread." Later in his reign he took it from persons guilty of robbing from the person, *petit* treason, and arson; and he also provided that actual clerks when delivered to the ordinary, should not henceforth be put to their purgation, but be imprisoned for life in the ordinary's prison. Subsequently, it was declared to be felony, without benefit of clergy, for anyone to break out of such prison; and authority was given to the bishop, if he choose to use it, to degrade an offending clerk from his ecclesiastical rank, and then to return him to the King's Bench, to be dealt with according to law, just as a soldier criminal may be punished and degraded in the presence of his comrades, and then be drummed out and handed over to the civil authorities.

Gradually, bit by bit—we are on the historical showing a Conservative nation—benefit of clergy was taken away from a number of capital felonies. Accessories in murder, cutpurses, burglars, housebreakers, horse-stealers, abductors of women, thieves stealing his Majesty's ammunition, and some others, were thus deprived. Elizabeth, besides abolishing all distinction between cleric and lay gave the magistrates power, in certain cases, to imprison clerks for a year without reference to the ordinary, and whipping was afterwards added to imprisonment. In some cases, transportation to parts beyond sea was permitted as the alternative of "clergy."

Women did not receive any benefit of clergy till 21 Jac. I. c. 6, which recites that many women were constantly put to death for offences which, if committed by men, would have been clergyable, and from that time forth granted them the same immunities as were enjoyed by men.

Though shorn of much of its glory, benefit of clergy remained till the year 1827 a feature in our legal system, the excessive severity of which—death, the penalty of all thefts of articles valued at more than twelve pence—it served to mitigate. But it was in itself more

THE LADIES AT THE TOURNAMENT.

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outrageous than sanctuary, and was perfectly intolerable to a people who had become so civilized that they were about to repeal the Corn Laws, to do away with the more intolerant of the disabilities of Roman Catholics, and to reform the constitution of their representative assembly. In 1827 it was utterly abolished, and the sanguinary code which it tempered was also done away.

In practice, benefit of clergy might be claimed, either in bar of the indictment, or in arrest of judgment. It was competent to a clerk to abandon his clergy, and stand his trial at common law, "and note," says Lord Coke, "when he knew himself free and innocent, then hee would be tryed by the common law; but when hee found himselfe fowle and guilty, then would hee shelter himselfe under the priviledge of his clergy."

WOMANKIND:

IN ALL AGES OF WESTERN EUROPE.

BY THOMAS WRIGHT, F.S.A.

(*With a Coloured Plate.*)

CHAPTER VIII.

WOMANKIND IN THE FEUDAL CASTLE (*continued*)—MARRIED LIFE—WOMAN'S WORK—WOMAN AS THE PHYSICIAN.

THE coloured plate which accompanies the present chapter, but which is more especially illustrative of the one which precedes, is taken from an illuminated manuscript of the fifteenth century. It represents the dames and damoiselles of the castle assembled on their stage to watch the events of the tournament.

The same freedom which has been described in the last chapter as prevailing in the relations between the sexes, continued after marriage. The wedded lady seems to have claimed the right of having a lover as well as a husband, and sometimes more than one. In the story of Aucassin and Nicolette, the former speaks with a sort of admiration of "the fair courteous dames, who have two lovers or three along with their husbands"—*les beles dames cortoises, que eles ont ii. amis ou iii. avoc leur barons.* The good knight of La Tour-Landry, in a discussion on this subject with his own lady, advances curious reasons why married women might love, *par amours*, other men beside their own husbands. "Why," asks the knight, "should not ladies and damoiselles love *par amours?* For

it seems to me that in true love there is nothing but good, and, just as the lover is more worthy for it, and shows himself more gay, and handsomer and better arrayed, and is more encouraged to follow arms and honours, and taketh, therefore, better manner in himself and better bearing in all conditions of life, in order to please his lady and his love, just so does she who is loved of him, to please him, since she loves him. And so I tell you that it is great alms when a dame or a damoiselle is the means of making a good knight or a good esquire."* These lines of the knight of La Tour-Landry breathe the whole spirit of feudal chivalry. Bravery and skill in battle on the part of the object were always a sufficient excuse for the lady's love, and he was proud of displaying the favours which not only gratified his passion, but which were his incentives to great actions, for, as the knight observes a little further on, "it must be a great act of goodness on the part of the ladies to make out of a man of nothing a man of valour and worth." The lady des Belles Cousines took the young Jean de Saintré into her favour, instructed him in the amorous science, sent him out to tournaments and battles, where he earned glory in her name, and then, when she thought he had done enough, she made him her lover.

In an early fabliau composed by a trouvère named Pierre Danfol, printed in the collection of M. Méon, a knight of Normandy pays his court to a lady, who refuses him her love until he proves himself valorous enough to deserve it.

Si li dist, en riant, sanz ire,	So she said to him, laughing, without anger,
Que de s'amor n'ert-il jà sire,	That of her love he will never be lord
Se si que sache, sans dotance,	Until she know, without doubt,
Conmant il porte escu et lance,	How he carries shield and lance,
Et s'il en set venir à chief.	And if he know how to conquer with them.
Méon, Fabliaux, tome i., p. 175.	

The knight offers, and receives her permission, to challenge her husband to a tournament, which is held in her presence, and in which the husband is overthrown. The lady is sorry for her husband's mishap, but she greatly rejoices at the success of her knight, and gives him her love without further hesitation. According to another fabliau in the same collection, there was a knight who was a great coward, and who was, therefore, despised by his wife. Three other knights aspired to her love, and she determined at last to take one of them. On the eve of a tournament the lady sent to the three knights her chemise, with a message to the effect that she

* "Le Livre du Chevalier de La Tour-Landry," edited by M. Anatole de Montaiglon, p. 247.

would give her love to him who would enter the combat with no other defensive armour, except his helmet, his chausses-de-fer, his shield, and his sword. The two elder knights declined the enterprise, but the youngest accepted the chemise, kissed it with transport, and, rushing eagerly into the combat, came out of it victorious but covered with wounds, and sent the chemise, bathed in his blood, as an offering to his lady. She threw it over her dress, and boasted of it openly in the presence of her husband. A similar case had been laid before the courts of love in Provence for their judgment on the merit of the lady's act.

Sometimes the lady's love was the reward of perseverance and of the display of the lover's devotion to her. The Chatelain de Coucy, according to the history, loved the fair lady of the castle of Fayel, and paid a visit to the castle in her husband's absence. The lady rejected his suit, as being contrary to her duty, and sent him away. Then he went about to jousts and tournaments, and gained so much fame, that his praise was heard even in the castle of Fayel, and the lady listened to it with pleasure, as she knew that all these brilliant feats had been performed for her sake. And he wrote songs upon his lady, which were sung before her by a jougleur, or minstrel, and, when she knew the meaning of them, her heart was still more softened. Nevertheless, in another visit to the castle of Fayel, the châtelain's suit was again rejected, though somewhat less obdurately. But he persevered, frequented the tournaments more than ever, and made songs upon his lady, which he sang himself. Gradually she became more yielding, and dreaded less the blame she might incur, until at last she threw aside all her scruples, admitted him secretly by night into the castle garden, and gave herself up to love:—

Dist la dame : "Certes bien croy,	Said the lady : "Truly I believe well
Que loiaus serés envers moy ;	That you will be loyal towards me ;
En moy arés loial amie,	In me you will have a loyal lover,
Car pooir n'ay que le desdie,	For I have not power to deny it,
Car ce qu'amours vient à plaisir,	For that which becomes love's pleasure
Convient-il chascun obéir."	Every one must obey it.

Hist. du Châtelain de Coucy, l. 3561.

A bad or tyrannical husband was another excuse readily allowed. One of the romances in the "Romancero François," that of Belle Emelos, by Audefroy-le-Bâtard, tells us how the fair Emelos, married to a duke, who beat and ill-treated her, sat disconsolate in the castle-meadow, thinking of her lover, Guy. Her husband overhears her, and goes and beats her, in great anger; but at the

same moment Guy comes, sees what has taken place, draws his sword and slays the duke, and carries the lady away on his palfrey. In another in the same collection, Bele Isabeaus, who loves Gerard, is forced by her parents to marry one whom she does not love. Gerard goes to visit her, finds her alone in a garden, and, in the midst of their transports, the husband becomes unexpectedly a witness, and in his grief drops dead on the spot. They bury the husband, and Gerard takes his place. The excellent editor of this poem remarks, *un peu malicieusement*, that there have been few husbands who acted on such an occasion so conveniently.

Jealousy was another quality unbecoming in a husband of gentle blood. Jealousy belonged to the bourgeois, and not to the knight. This passion forms the groundwork of the "Roman de Flamenca." The fair Flamenca, daughter of Gui de Nemours, is married to Archambaut, lord of Bourbon, and the nuptials are celebrated with a splendid festival, accompanied by a grand tournament, in the course of which Archambaut is made jealous of his young wife. This jealousy becomes a ruling passion with him, and he shuts his wife up in a tower of his castle, which he never allows her to quit, unless on Sundays and the church festivals, when she went to church under his own escort, or when he took her to the baths of Bourbon, with two of her damoiselles, locked them up in their bath, and carried the key with him till he let them out. Flamenca long pined under this confinement, and under the ill-treatment to which she was subjected; until at length a young knight of Burgundy, named William, heard of her story, and he resolved to offer her his love, and to deliver her. He eventually caused to be made secretly a subterranean passage leading into the bath, which now becomes the safe scene of their interviews, while Archambaud believes that his wife is alone, accompanied only by her two damoiselles. The lady soon yields herself to William's embraces, and finally he carries her away. Previous to the interview in the bath, when William's love is accepted, he obtains Flamenca's permission to bring with him two of his esquires, and, while the principals are engaged in the chief room of the baths, the maidens, at the bidding of their mistress, yield to the esquires in rooms adjoining. The damoiselles are always found aiding and advising their ladies in these intrigues. The chambrière of the lady of Fayel performs this office towards her mistress, and even risks her own reputation to cover her amour with the Chatelain de Coucy.

All these facts, and many of a character which I could less easily quote, show us that, under the external pride and pomp of the

mediæval castle, the degree of morality which prevailed in its society was not very high. There was, indeed, no real check upon it, for even religion, as it was then cultivated, and especially the system of confession and absolution, was calculated rather to screen immorality than to prevent it. The following tale, found in manuscripts of the fourteenth century, will be found in my "Selection of Latin Stories":—"A certain esquire had committed adultery with the wife of his lord, and began on this account to be an object of scandal; and when the knight his lord heard of it, he took with him the said esquire to a man possessed with an evil spirit (*dæmoniacus*), who was in the habit of accusing many people in public of the sins which they had committed secretly. The squire, knowing, therefore, that he was taken to the dæmoniac for this cause, and conscious of his guilt, obtained licence from his lord, for a case of urgent necessity, to go to a neighbouring town, and there he made a full confession to the priest of this as well as of his other sins, and having received from the priest penance and very severe discipline (flogging), returned to his lord. And when they came to the aforesaid dæmoniac, the knight interrogated him as to the character and deeds of his esquire. To whom the dæmoniac replied, 'Yesterday morning, when he started with you, I knew him and his deeds well; but now they are known only to him who has made his back bloody, nor am I able to say or know more of him.'" This anecdote was told by the priests themselves, as a good illustration of the efficacy of confession. *

This laxity of manners also explains why, during the feudal period, illegitimacy of birth was considered so little dishonourable, that the word which designated it was commonly adopted as a surname. The first of our own Norman kings was William the Bastard; and one of the most distinguished of the knightly poets of the Romancero, at the beginning of the thirteenth century, who appears to have lived in Artois, was Audefroy le Bâtard.† In one of the "romances" of the latter, the fair Beatris, a daughter of high family, is already pregnant by her lover, the knight Ugon, when she is sought in marriage by the duke Henri. Her father will force her to marry the duke, but she sends to her lover, who meets her at night in the garden of her father's castle, carries her off to his own territory, and there marries her.

* "A Selection of Latin Stories, from manuscripts of the Thirteenth and Fourteenth Centuries" (published by the Percy Society), p. 33.

† Among the members of the knightly family who lived together in his household, Adam du Petit Pont, towards the middle of the twelfth century, enumerates illegitimate children of the husband and illegitimate children of the wife. See Scheler, "Lexicographie Latine du xii[e] et du xiii[e] Siècle," p. 123.

As it appears from this story, the father still claimed the absolute right of disposing of his daughters. In the "Roman du roi Flore et de la belle Jeanne," of the commencement of the thirteenth century, we are told of a knight who had a beautiful daughter, named Jeanne, and a faithful and favourite esquire named Robin, to whom he proposed to give his daughter in marriage, as a mark of his esteem, though in regard to position the match was very unequal. The knight's lady, when she was told of his intention, protested against it, but without effect, and she appealed to her relatives, who refused to interfere, telling her that her husband was a knight, brave and powerful, and that he had the right of dis-

BETROTHAL OF YOUNG NOBLES.

posing of his daughter at his will (*il puet faire de sa fille sa volenté*). The knight sent for his chaplain, caused him to perform the ceremony of betrothal, and fixed the day of marriage.* In the whole

This ceremony is represented in the cut, taken from a French illuminated manu- of t a period.

of these proceedings the damsel appears not to have been consulted. In the romance of "Bele Idoine," who is a king's daughter, but who loves a gallant knight, the Count Garsiles, the damoiselle is betrayed by her *maistre*, or duegna, to the king her father. The latter, angry that his daughter should have formed relations of this kind without consulting his will, not only stripped and beat her severely, but shut her up in a tower, where she remained three years. I could give many examples of the exercise of this sort of paternal authority, but the father became gradually less arbitrary. In the pretty little novel of the Countess of Ponthieu, of the thirteenth century, when the count agrees to give his daughter in marriage to Thebaut, lord of Dommare, he said, "I will give her to you, *if she will it;*" and so, when Flamenca is given by her father to Archambaut, her consent is made a condition of the gift. However, to judge by the contemporary records of the history of manners which I am using, it had become by no means an uncommon thing for the daughter to make her own choice, and contract a runaway match. The opposition of the father usually arose from pride, or from selfishness; he was unwilling that his daughters should marry below his own rank and position, and he was desirous of disposing them in a manner which would bring, either by family alliance (which was of great importance in feudal times), or by the acquisition of wealth, advantage to himself. Love between those who were not equals in rank and wealth was very natural where, as already stated, the sons and daughters of the vassals were collected together in the household on a footing of social equality. Many examples might be quoted from mediæval literature and romance.

The act of betrothal, which in earlier times was one of great consequence to the fathers of the two individuals most interested in it, and which was frequently performed in their childhood, had now lost much of its importance. It was still performed ceremoniously by a priest, in the presence of the parents and of witnesses, as shown in the picture we have given above. In the case of Jeanne and Robin, told before, the betrothal took place only six days before the marriage; but the usual time seems to have been a month. This was the case with the *très chevalereux* Comte d'Artois. The accompanying cut, copied from a fine illuminated manuscript of the latter half of the fifteenth century, in the British Museum (MS. Reg. 14 E. IV., fol. 284, r°.), represents a royal marriage ceremony, no doubt much in the manner in which it was performed throughout the feudal period. Many of the relations of marriage appear to have been still under the influence of the clergy,

which, easily ruled by interested motives, had long been a subject f complaint. In England, already in the reign of Edward II., a

A ROYAL WEDDING.

popular poem on the corruptions of the time puts forward as a subject of complaint the facility with which, through the intervention of the priesthood, a man who had the means could get rid of his own wife, and take another man's in her place.*

If a man have a wyf,
And he love her nowt,
Bryng hyr to the constery (*consistory court*),
Ther trewth schuld be wrowt.
Bring twei fals wytnes with hym,
And hymself the thrydde,
And he schal be deperted (*divorced*),
As fair as he wold bydde,
From his wyf;
He schal be mayntend fulle wel
To lede a sory (*disreputable*) lyf.

* "A Poem on the Times of Edward II.," published by the Percy Society, p. 17.

When he is deperted
From hys trew spowse,
Take his neyghebores wyf
And bryng her to howse (*bring her home*),
Yif he have selver
Among the clerkes to sende,
He may have hir to hys wyf
To hys lifes ende,
With onskylle (*with wrong*);
Thei that so fair with falsenes dele (*deal*),
Goddes corse on her bille (*on their mouth*)!

We must not suppose that the ladies of the household were idle. They it was who, as in earlier ages, produced the materials necessary for a great part of the clothing of the family. Adam du Petit Pont, a scholastic writer of the twelfth century, describing a knightly mansion in his native England, says that, as they went round the house, they saw a chamber looking upon the garden, which was the *gynæceum*, or room of the women, and, approaching, they saw, collected inside, linen warp, woof, and other objects of a similar description, as well as various implements and machines used in working linen and woollen, and also the different stuffs thus produced. In this room the lady of the castle and her damsels passed much of their time, probably the whole of the morning previous to the dinner. A short poem in praise of the sex, entitled "Le Bien des Fames," printed by M. Jubinal, tells us that—

Mult doit fame estre chier tenue;	Much ought woman to be held dear;
Par li est toute gent vestue.	By her is everybody clothed.
Bien sai que fame file et oeuvre	Well know I that woman spins and works
Les dras dont l'en se vest et cuevre,	The clothes with which we dress and cover ourselves,
Et toissus d'or, et drap de soie;	And gold tissues, and cloth of silk;
Et por ce di-je, où que je soie,	And therefore say I, wherever I may be,
A toz cels qui orront cest conte,	To all those who shall hear this story,
Que de fame ne dient honte.	That they say no ill of womankind.

The ladies of the castle are sometimes introduced at their work in the romances, and in the illuminations of manuscripts. In the latter the process of spinning thread is, perhaps, the one most frequently represented. The accompanying cut, taken from a manuscript of the Bible of the fifteenth century, in the Imperial Library in Paris, represents a lady thus employed. The distaff, or, as it is called in French, *quenouille*, was still so completely the woman's implement, that during the feudal period property which went in the female

A LADY AT THE DISTAFF.

line was said to descend to the *quenouille,* or distaff, and an heiress was called in France an *heir de quenouille.* The crown of France, strictly subjected to the Salic law, was said legally never to go to the distaff (for, in the primitive ages, queens were employed in spinning, like the rest of their sex). For the same reason, as spinning was one of the first works in which the damoiselle was instructed, and in which they were all proficient, the word *spinster* has become the legal designation of a woman who has not been married, not because spinning was not continued after marriage, but because it was looked upon as the young unmarried woman's chief occupation. In fact, according to old tradition and legend, it had been almost created with her. The old popular proverb told of the time "when Adam dolve and Eve span;" and in that charming illuminated manuscript known as Queen Mary's Psalter (MS. Reg. 2 B. VII., fol. 4, v°., of the beginning of the fourteenth century), the first pair are represented thus employed, Eve seated with her distaff, with the marginal explanation, "here Adam digs ground in the world, Eve spins to make dresses":—

A LADY SPINNING.

> Icy fugit Adam en secle tere,
> Eve file pur robes fere.

Even in the oldest of Greek legends and traditions woman is known as the spinster. The old poet, François Villon, speaking of Sardanapalus, says that he—

> En voult devenir moulier (*woman*),
> Et filer entre pucellettes.

A LADY CARDING WOOL.

The cut given above, taken from an illuminated manuscript of the fourteenth century, in the British Museum (MS. Reg. 10 E. iv.), represents a lady spinning on the wheel.

Our next cut represents one of the ladies of the household carding or combing her wool. This

also was an important part of the ladies' work, and a pair of cards was as necessary an article of the furniture of a house as a distaff, or a spinning-wheel. In the English wills and inventories of the fifteenth century, we find frequent mention of a "pair of cards." Every household of any importance had also its loom or looms, and weaving appears to have been looked upon as a superior grade of ladies' work, and in illuminations is generally exercised by the lady of the house. Our cut is taken from an illumination of the French translation of Boccace, "des Nobles Femmes," in which it illustrates the story of the wife of King Tarquin. As was the custom of the middle ages, and especially of the earlier period, the queen herself and her damoiselles employed themselves in the same kind of domestic occupations, and she here presides at the loom, while one of her companions is occupied with her cards or combs, and her carding-stock, and the other with her distaff. In the literature of the middle ages, the ladies are not unfrequently spoken of as engaged in weaving woollen or linen. Thus, in a fabliau of the trouvère Rutebeuf, a woman pleads as an excuse for remaining up late at night, that she was obliged to finish a piece of linen cloth she was weaving,—

A QUEEN AND HER DAMOISELLES.

Sire, fet-elle, il me faut tramer	Sir, I am obliged to work
A une toile que je fais.	At a linen cloth which I am making.

In my "Collection of Latin Stories" (p. 9), there is a tale of a woman whose husband was on the point of death, and who had already lost the use of his tongue and other members, and told her maid to go in haste and buy three yards of coarse cloth of borel to make him a shroud. The girl replied, "Madame, you have plenty of linen cloth [of course, of her own making], give him four yards or more for his shroud." To which the high dame replied indignantly, "Three yards of borel are enough for him." And the dis-

pute between mistress and maiden rose so high, that the dying man was roused to make use of his tongue also. Our next engraving represents a domestic loom of a later period: it is taken from one of the illustrations to Erasmus's well-known book, "The Praise of Folly."

A LADY AT HER LOOM.

When the ladies had thus woven their cloths, they either laid them by, or immediately made them into the articles of clothing which were wanted. In the romance of "The Death of Garin le Loherain," the Count Fromont, entering the chamber of the fair Beatrice, finds her occupied in sewing a very rich *chainsil*, or petticoat—

> Vint en la chambre à la bele Beatriz;
> Ele cosoit un molt riche chainsil.

Among the subjects of the side compartments of a print by Israel van Mechelin, we see a lady, apparently the mistress of the family, engaged in cutting up a piece of cloth to make it into garments, while two of her damsels are at work at their distaffs. It is given here in the cut in the margin.

LADIES AT THEIR WORK.

In the romance of "La Violette," a burgher's daughter is described as seated in her father's chambers, making a stole and amice in silk and gold, and as working with great care "many a little cross and many a star." And in the fabliau of "Guillaume au Faucon," a young bachelor, who enters suddenly the chamber of the ladies, finds them occupied in embroidering on a piece of silk the ensigns of the lord of the castle. It appears, indeed, to have been a point of pride among the ladies of the castle to be skilful in the art of embroidery. The cut in the margin, taken from a beautiful illuminated manuscript of the fourteenth century in the

EMBROIDERY.

British Museum (MS. Reg. 2 B. vii.), represents a lady thus employed. Sometimes the daughters of a high family learnt still richer and more delicate work. In the fabliau of Richaut, printed in the collection of Méon, we are told of a knight's daughter who was entrusted to a burgher to learn *orfrois*, or the art of embroidering in gold and silver.

C'est la fille à un chevalier	She is the daughter of a knight
Prou et cortois,	Noble and courteous,
Qui l'a mise chiés un borjois,	Who has placed her with a burgher,
Qui l'aprant à ovrer orfrois	Who teaches her to work *orfrois*
Avec sa fille.	Along with his daughter.

The mediæval ladies were possessed of another accomplishment, and one of great importance in those days—they were physicians, and, to a certain degree, surgeons. The question of allowing women to practise as doctors has been a subject of great discussion of late, but in and before the feudal period it was regarded as one of the natural duties of the sex, for men skilled in these professions were not usually at hand. In the pretty little novel of "Aucassin and Nicolette," of the thirteenth century, the former having fallen from his horse on his shoulder, the damsel Nicolette subjected the injured part to a skilful manipulation and found that the shoulder was dislocated. "She handled it so with her white hands and laboured so much, that, by God's will, who loves lovers, it came into its place; and then she took flowers and fresh grass and green leaves, and bound them upon it with the flap of her chemise, and he was quite healed." In another little novel or romance, that of "Amis and Amilon," when the latter is struck with leprosy, the wife of his friend Amis takes him into her chamber, strips him of all his clothing, bathes him herself, and then puts him to bed. So, in the Roman de la Violette, the damoiselle of the castle takes Gerard, who is carried in desperately wounded, into a chamber, and there divests him of his armour, undresses him, and puts him to bed. The damoiselles then examine all his wounds, apply to them ointments of great efficacy, and he soon recovers. Many similar examples might be quoted. The accompanying sketch of the interior of a chamber is taken from the illuminated manuscript of the "Historia Scholastica," of the date of 1470, in the British Museum (MS. Reg. 15 D. I.), but is here copied from Shaw's "Dresses and Decorations." It illustrates the history of Tobit, who is represented lying blind and sick on his couch, while his wife Anna is preparing a medicine for him, in doing which it will be remarked that she is following the directions of a book. Collections of

medical receipts are found in abundance in all periods of the middle ages; and it must be borne in mind that, in those ages, women, and not men, were usually able to read and write.

THE LADY AS PHYSICIAN.

A VISIT TO MATHERAN.

BY J. G. HALLIDAY, LIEUT.-COL.

In England, when "jaded and the springs relaxed," the human machine needs rest and refreshment, it is to the sea-shore, or to country scenes at home or abroad, that one runs. Here, in India, when we long for a respite from the monotonous routine of official or of cantonment life, we generally turn our eyes to some one of those various hill ranges which are so liberally scattered throughout the Peninsula, from the snow-capped Himalaya in the north to the Neilgherries and Pulneys in the south; all so full of beauties of their own, and of so many and peculiar interests to those who have their eyes open to the intellectual observation of nature in any of her departments.

Being stationed at Poona, in the Bombay Presidency, and having the opportunity of availing myself of a much-needed holiday, the question, "Where shall we spend our holiday?" had to be solved. Mahabaleshwur, not far distant, held out many attractions, but circumstances led us ultimately to fix upon Matheran as the place of our destination. It is within easy reach by railway from Poona, and we had promised ourselves a short and pleasant trip, and an early arrival to a well-earned dinner; but we found that the course of holiday-seeking, like that of true love, does not always run smooth; for, beginning by just missing the train by which we had intended travelling, our journey was a series of delays and mishaps, so that we did not reach our destination till midnight, missing thus, on our first ascent, the interest and beauty of the ghaut, and finding all our servants left behind, so that for fully twenty-four hours we had to rough it indeed.

In the course of our journey we noticed the pretty *Vitex trifolia* growing and flowering in great luxuriance at Khandalla, at the head of the Bhore Ghaut.

But if our arrival at Matheran was thus a little uncomfortable, there was much to repay in the beauty of the place, as it opened before us on the next morning. Surrounded by thick forest and jungle, so as entirely to shut out all view of roads or neighbouring bungalows, the view from our verandah was one which, with all its constant changes, in bright sunshine or mist, or heavy rain, or that wonderful clearness which follows a good *washing* of the atmosphere by a monsoon shower, I never tired of. A little terraced garden, brilliant with many flowers, especially one central bush of *Bougain-*

villæa, giving such a mass of colour as I have seldom seen. Immediately beyond it the forest commenced, but running down a ravine so steep, that the tall trees did not in the least intercept the view; those trees, so green and refreshing after the burnt-up dusty plains we had left, and holding forth so much promise of interesting study; and then, beyond the ravine and over a narrow valley, a range of hills so remarkable and fantastic in their shapes, as to have given rise to many and various comparisons—cathedrals, pagodas, castles, what-not—and their flanks marked, as are most of the hills hereabouts, with the curious parallel roads or water-level marks, carrying one back to such wonderful antiquity, and giving rise to such interesting speculations on their cause.

But I have no intention of giving a diary of our stay on Matheran, which could be of little interest. We found ourselves there about the middle of April, with the prospect of remaining till towards the middle of June, when we should be driven down by the burst of the south-west monsoon, which exerts its full force on all these hills. Matheran is one of many hills which stand out between the general chain of the Western Ghauts and the sea. The general character is, exceedingly precipitous sides, cut into by deep ravines, and flat tops, while in a few instances, as has been mentioned, they are carved into most fantastic shapes. But it is with Matheran only that I have to do; so to it I will confine myself.

The highest summit, Panorama Point, is said to be 2,600 feet high; the principal parts not quite so much. The table land is, I think, less than four miles from north to south, with two smaller parallel spurs, one west and the other east of the main hill, each about a mile and a half or two miles long. The broadest part, from east to west, does not exceed a mile, so that the space we had for study was not very extensive. We soon found, too, that the end of the hot season, when all the water-courses were dry, and many of the springs failing, was not the most advantageous for studying either the Flora or Fauna of the place. But yet there was no lack of objects of interest. In June, before we left it, we had an abundant share of rain, which had an immediate effect on animal and vegetable life; but I have no intention, as I certainly have not the necessary qualification, of giving anything like a complete catalogue of the local productions, only wishing, in fact, to mention what actually came under my own observation.

The hill is capped everywhere with laterite, which affords very rough walking, and, where broken up, a very heavy and penetrating red dust; but the disintegration of the rock, mixed with the abun-

dant vegetable mould, furnishes a most productive soil, as testified by the abundant vegetation, even at this dry season. One has, however, to go but a short distance down the ravines to come upon the amygdaloid trap, the prevailing rock of all this part of the ghauts. In drases here, as elsewhere, are found most strikingly beautiful crystals, some specimens of which we were able to carry away with us.

CLIMATE.—Matheran is a favourite hot weather resort from the stifling closeness of Bombay, but to us, as compared with some of the other hill ranges of South India, the climate was disappointing, nothing ever approaching to real cold during the period of our visit, and the power of the sun much too great for, at all events, the ladies of our party to enjoy mid-day rambles or explorations through the woods. The maximum heat registered during our stay was 95° Fahrenheit, and the maximum of the coolest day reached 78°. The average maximum of forty-two observations on one of Negretti and Zambra's patent maximum thermometers was 86° 5′. The maximum temperature of our coolest night was 68°, that of our warmest night being 78°, and the average maximum at night (on forty observations) was 71° 5′. The greatest difference between the wet and dry bulbs of a Mason's hygrometer ever reached at the hottest part of the afternoon, when we first came up, was as much as 21° 5′, varying from that up to complete saturation, when the rolling clouds enveloped us for a week before we left the place.

HYMENOPTERA.—I was early struck by the wonderful abundance and variety of Hymenopterous insects. The air, especially around certain trees in blossom, and towards evening, was vocal with the hum of bees, some large and some very minute, often of considerable beauty. Some of these bees make their hives on the face of rocks, in places which would appear entirely inaccessible to man; but the natives manage to get at and to rob the hives, and, as the result, they sell very excellent honey. The largest of the genus, Apis, is the huge *Xylocopa latipes*, every part of whose organization is admirable. I have found, especially, the tongue, and the curiously hairy tarsi of the anterior pair of legs, to be worthy of microscopic examination. A colony of these insects had taken possession of an old dry stump, in which they bore large cylindrical holes with accuracy and celerity, and in the neighbourhood of this stump I could always catch them, though the sharp vision of their large blue-grey eyes necessitates some expertness. I was amused and surprised one evening, standing in the neighbourhood of this stump, when numbers of a peculiar kind of moth were flying about, to see the

Xylocopas dart after them, over and over again, like a hawk at its quarry; but though this was repeated so frequently that there could be no doubt about it, I failed to observe one strike a moth, and so could not divine the object.

The wasps are also well represented, social and solitary, mason and burrowing; and besides the interest of watching their operations, I was able to add some magnificent metallic Sphexes to my collection.

Ants of all sizes and colours abound, and are as busy and troublesome as is their wont, but none the less worthy of observation—some varieties especially so. One minute dark-coloured tree ant constructs a hanging nest, at first sight strongly resembling a wasp's nest, but that it is made of dried leaves, laid one over the other, and curiously cemented together, so as to give the whole an imbricated appearance. The ants are seldom seen during the day, but any disturbance of the tree or of the nest brings them out in thousands. Another kind makes smaller nests, a mere film, of a dark waxlike substance, surrounding a small branch generally at the fork. Then the fortification ants, another minute variety, but quite black, and building in the ground, are note-worthy. Their nest externally is marked by a number of concentric circular mud walls, about an inch, or inch and a half high, and at about the same distance apart. The innermost of these is always somewhat the highest, and from within this inner intrenchment descends the shaft leading to the subterranean nest. I have never observed these ants elsewhere, and it is not quite plain what purpose their successive lines of circumvallation can serve them. These, also, are seldom seen during the heat of the day, but are at work morning and evening. There is, I think, invariably a rubbish-heap, consisting mainly of the chaff of grass, the heads of which they have laid up in store on one side, just beyond their fortification.

NEUROPTERA.—The Neuroptera are also well represented. Termites of more than one variety; Myrmeleonidæ and Libellulidæ: some of these dragon-flies are very handsome from size or colour, but I know not that I observed anything very remarkable in this division of the insect world. A peculiar kind of rather small dragon-fly has the habit of settling at night in vast numbers upon some one shrub, and it is somewhat startling, when pushing through the jungle towards evening, to disturb them, as they suddenly fly off in dozens.

DIPTERA.—Some small Diptera I have found to rise much in the same way from stones in the dry beds of the water-courses.

Musca domestica, of course, abounds, as every where; and there is one large heavy Musca whose antennæ, proboscis, and feet, I have found furnish fine microscopic objects. The horse-fly, Tabanus, became very troublesome towards the end of our stay, not only to our animals, but even molesting ourselves. A very beautiful Diopsis much interested me. I did not succeed in taking many. One member of the Diptera we were glad to miss. Mosquitos seem almost unknown at this season: a few appeared in the heavy rain just before we left.

HEMIPTERA.—The Hemiptera are well represented. I found some of great beauty and brilliant colouring, but not differing from what I have observed elsewhere. *Cicada stridula* was making the woods joyous with his peculiar love-chirp till about the 20th of May, when it entirely ceased. But the song was then taken up by a large cricket (*Acheta membrenacea,* perhaps), with the advantage that it chirped by night as well as by day.

COLEOPTERA.—During the earlier part of my stay I was struck by the absence of beetles, but several made their appearance so soon as damp weather set in. Some very noteworthy Prionidæ, some as much as two and a half inches in length, which would fly into the room in the evening, when lamps were lighted, with a peculiar and somewhat musical hum. A very beautiful Cyclica, of a rich metallic green, covered with bristling spines: it is a little beetle, barely a quarter of an inch in length, found very abundantly on the leaves of *Ziziphus Rugosa.* (To preserve their metallic lustre they should be mounted in balsam, or kept in spirit.) On two or three distinct kinds of trees I noticed a very neat example of a "home without hands." The long leaf of *Terminalia chebula,* for instance, is cut across from one edge at right angles, and a little beyond the mid-rib the loose hanging flap thus produced is rolled tightly up, the ends tucked in in a most compact manner, and this contains a coleopterous larva. From the description given to me of it, it must closely resemble, if not be identical with, *Casnonia longicollis,* with its long pliable neck and curious head and mandibles.

About the 15th of May, the fireflies (are they Elateridæ ?) began to appear in a few solitary instances; but by and by, as the season went on, they increased amazingly, their beautiful lilac phosphorescence flashing among the trees, sometimes with a brightness that was quite surprising in so small an insect. But it is very intermittent, and always appeared to me in great measure subject to the voluntary control of the little beetle. They came in numbers into the house, and it was a curious and pretty sight, when the lights

were put out at night, to see the ceiling all sparkling with these minute twinkling stars. I one evening watched a large gecko on the wall of my room, making a meal off these little shining morsels; their light must have been a disadvantage to them, in this instance at least, guiding the enemy to them; as he snapped them up, held them a moment between his powerful jaws, and then swallowed them, the light seemed to continue to shine to the last.

The Lampyridæ are also represented, for I found glowworms fully an inch and a half in length, of singular brightness, and having two luminous spots in the tail, the head retractile under the broad shield of the first segment of the body; but I did not succeed in noticing the male of this species.

Lepidoptera.—I have left the Lepidoptera to the last of the insect tribes, not certainly because they are least important, for Matheran is justly noted for the beauty and variety of its moths and butterflies, and though the season of our visit there was not the most favourable of the year, yet I was able to add very considerably to my collection.

A few days after our arrival I captured the rare and very peculiarly-shaped *Amathusia philarcus*. It is a very imperfect specimen, but I never succeeded in finding another, though some entomological friends were more fortunate. In shape and size it closely resembles an Amathusia which I have from Cashmir, but is less brilliantly coloured above. On the underside in the Matheran one, as well as in the Cashmirean, the four wings exactly resemble four dried leaves, even to the well-marked midrib. The king of the day-flying Lepidopteræ is *Papilio ornithopterus*, measuring about five and a half inches across the wings, and with a strong flight, which makes its name peculiarly appropriate. It is of a deep velvet black anteriorly shading off into a handsome blue grey posteriorly. *Papilio Sarpedon* is another very beautiful insect, and rare, except in the neighbourhood of certain trees in blossom, his greenish blue band passing across both pair of wings, contrasting finely with the prevailing deep black colour. Other Papilionidæ, not uncommon in other parts of India, are also abundant, one very handsome and active, spotted black and light green, I have not succeeded in identifying. Among the many and brilliant Theclas is one closely resembling, if not identical with, *Thecla orcas* (of Drury), the wings bordered and fringed black, and of a magnificent metallic blue: another closely resembling it, but with a large reddish spot on the anterior wing. These are excessively local, confining themselves often to one particular tree. Of the Nymphalidæ, besides

Amathusia philarchus mentioned above, there are several remarkable specimens, of which I can only enumerate *Chaxis nephon*, a large and very handsome Diurna, rather abundant in the Western Ghats, but less so on Matheran, at least at this season. The wings of a burnt sienna hue, bordered with deep purple; the posterior wings each terminated by two tails. It is very strong on the wing, generally flying high, and thus difficult to capture; but if a stick, or some such object be tossed up, it will sometimes come down towards it, as though out of curiosity, and thus give the opportunity. *Charaxis athamas* is a more elegantly-formed insect, handsomely-coloured black, with a bright yellow diagonal bar, and is somewhat scarce. There are numerous day-flying moths; one, large and rather handsome, blue and black, with banded yellow body, is exceedingly abundant, which, though flying more boldly in the twilight, yet keeps on the wing all through the day. It has the power of emitting from the joints of its body a very unpleasant fluid, which apparently protects it from the attacks of hungry birds. Among these crepusculariæ, a little Zygæna, very like *Z. fenestrata* (Fabricius); and of the Sphingidæ, *Deilephila clotho* (Drury); *Macroglossa Passalus*, and some large *Œgerias*, with their beautiful membranous wings, may be named. Pre-eminent among the Nocturnæ, not of Matheran merely, but so far as I know of the world, is the splendid *Saturnia Atlas*; the one which I was fortunate enough to add to my collection (through the kindness of a friend), measures seven and three quarter inches across the wings; it is a male, the females being considerably larger. It is a sluggish animal, and I never heard of anyone who had seen it on the wing. The larva is said to feed upon *Atalantia monophylla*, but I never found it myself, and the shrub shown me was certainly not an Atalantia, nor even an Aurant at all. *Saturnia Melita* is not uncommon, and an Erebus not unlike *E. odora* (Lat.) on the upper side, but dotted with white on the underside, is very common.

Articulata.—Very large and formidable-looking Scolopendria (centipedes) are common enough when the rain falls. The segments of the body are coloured alternately deep brown and bright yellow. I measured one which came into our sitting-room one rainy night, and found it just within six inches. Of the Arachnidæ, nothing very remarkable came under my own observation. The large black scorpion, common in most parts of India, is common enough on Matheran also, where I killed several very large ones.

Reptiles.—I noticed a small Hyla, of a dull brown, differing thus in colour, as well as in size, from the handsome green-tree frog

common in India; it seemed also less active in habit. Snakes I saw but very few, though I often noticed their marks and traces, and heard accounts of several, some considered very dangerous, and also of some very large Pithons.

BIRDS.—The woods abound in birds far beyond my power to describe or to name; but I was struck at the entire absence of the common house-sparrow, generally so persevering a companion of man in all his habitations, but he has not followed man up to Matheran. The common pariah kite (*Milvus govinda* of Sykes) is common. The carrion crow (*Corvus culminatus*, Sykes) I saw occasionally, and *Corvus splendens* is abundant, and impudent as is his nature. A martin (perhaps *Cotyle concolor* of Sykes) I saw sparingly. *Megalaimis viridis* (Gmel.), a very pretty small green barbet, is often seen. So far as I could perceive, it does not seem to climb or tap the trees like a woodpecker; its flight is direct and rapid. Jerdon mentions that it calls by moonlight. *Endynamys orientalis* (Lin.), the Indian koel, is heard in the woods; as is also the very peculiar hoot of *Centropus rufipennis* (Illiger), the so-called crow-pheasant. Sometimes two of these birds will continue answering one another from a considerable distance for a long time. The pretty purple honey-sucker sun-bird, as Adams calls him, *Arachnecthera Asiaticus*, flits about among the trees of our garden; but a far more beautiful nectarinis, *Leptocoma minimus*, in which the purple is enlivened with brilliant crimson, is also very common, coming close to the house; he, as well as most of the birds on Matheran, being fortunately but little disturbed, is very tame. This tiny honey-sucker had his nest in a cluster of roses and passion-flowers in our garden, and looked himself, as he flitted by, like an animated flower. *Pericrocotus flammeus* (Forster), belonging to the family Campephaginæ, I saw but one specimen of, but he gave me full opportunity of admiring his splendid plumage, as he perched quite near to me one morning when I was out sketching. The head, back, and tail are of a glossy purple; neck, chest, and rump, and a broad wing stripe, a rich orange-crimson; the total length of the bird about 6½ or 7 inches. The trees immediately below our house were thickly-peopled by the bulbuls, both the common bird, *Pcynonotus hæmorhous* (Gmelin), and a red-whiskered one (*Otocompso jocosa*, Lin., as given by Jerdon) much handsomer. Their song during the early morning, especially so long as the birds were still occupied with their young brood, as was the case during the earlier six weeks of our visit, was very delightful. The bulbul taken young makes an admirable cage-bird, becoming exceedingly

tame. The Indian oriole (*O. kundoo* of Sykes) I caught sight of but once or twice, with his black and golden-yellow plumage, flitting among the thickest trees. *Acridotheres tristis* (Lin.), the common myna, is as numerous and as voluble as elsewhere in India. Why "tristis" for this active, fussy, strutting starling, with plumage, too, not remarkably sad? *Thamnobia cambaiensis* (Latham), the brown-backed robin of Jerdon, is very common. I once found the neat nest of a weaver-bird, *Ploceus baya,* hanging from a branch, and containing one very small pale-coloured egg. *Galloperdix spadiceus,* the red-spur fowl, I frequently came upon, running among the roots of the trees in the forest, and taking to the wing only when I came quite close to it. It has a fine crow, often heard. There is a bird whose whistle is very peculiar and characteristic of the place; I know not that I have noticed it elsewhere—it is known among the European visitors of Matheran as the "whistling schoolboy"—*Myiophonus Horsfieldi* (Vigors)—whistling thrush of Jerdon. I often heard it from the earlier days of our visit, and latterly, when the heavy rain set in, almost continuously. The whistle so remarkably resembles that of a man, that even to the last, when heard during my solitary rambles in the woods, or in the neighbourhood of our house, I had to persuade myself that it was indeed the bird. The black-capped blackbird, *Merula nigropileus,* occasionally treats one to his rich notes very early in the morning.

MAMMALS.—Of the mammals, numerous as they are, I am not prepared to say much. The squirrel differs from the common-striped squirrel of the plains, being much darker and generally dingy, and is, no doubt, *Sciurus tristriatus* of Jerdon. Several of them had taken up their abode in the thatch of our bungalow, and in the trees around; but though occasionally coming down to the ground, they do not feed upon it, as is the habit with the common *Sciurus palmarum.* Their chirp is very like that of a bird. A monkey, *Macacus radiatus,* probably, is often heard hooting in the thicker parts of the woods, and, when out sketching or botanizing, I have come pretty close to them.

MISCELLANEOUS.—The Helicidæ are very numerous, though during the dry season it is only the empty shells that are found in great numbers, generally under rocks. I have brought away some shells exceedingly delicate, belonging to the genus Helix, and some very pretty Clausiliæ. As soon as the rain falls heavily, and the streams are full, good-sized crabs, fully three inches across the carapace, are seen running about the lower slopes of the hills; while the thickets abound with a minute leech, which renders walking through the

jungles just when they are most interesting to explore, somewhat disagreeable. These leeches are common enough in most jungly tracts of India during the rains; but it becomes a curious question where they, as well as the crabs just mentioned, conceal themselves during the scorching months of the dry season.

(*To be Continued.*)

MULLUS SURMULETUS:

HABITS OF THE SURMULLET IN ANCIENT AS COMPARED WITH MODERN TIMES.

BY JONATHAN COUCH, F.L.S., M.Z.S., ETC.

There are few of our more common fishes, of which the habits have been less certainly known than the Surmullet; and this is especially the case as concerns the time and manner in which the spawn is shed and the young are produced, to which may be added the cause of their abundance or scarcity from one season to another: and, again, their food, with the manner in which they are accustomed to procure it. Among the most ancient writers on natural history there is frequent reference to this fish, which indeed seems to have drawn to itself more of the notice of the public than perhaps any other; so that even the medical writers have specified its healing or hurtful influences, which were supposed to vary according to the manner in which it was killed; and the satirists of the times of the Roman Empire have forcibly directed attention to the fashionable extravagance in which the higher ranks of their countrymen were accustomed to indulge themselves in the purchase and preparation of this fish. But notwithstanding this, so little were they inclined to study nature in its simple truth, that, except as regards its changes of colour in dying, there is little to be found in the writers of Rome that throws light on its nature, or its manner of living when free in its native element. The writer Apuleius, best known as the author of the "Romance of the Golden Ass," had closely studied the structure, and perhaps the food and habits of the fishes of the Mediterranean; but the only particulars we have a knowledge of in connection with these researches are, that they brought him into trouble under an accusation of having employed his acquirements in natural knowledge to the purposes of magic; and no work of his on this subject has come down to modern times;—if indeed such a work was ever written.

When seeking to be informed of what was known on this subject

in ancient times, our chief reference must be to Greek writers, who speak of the Surmullet under the name of Triglè or Triglis: and, says Gesner, "if Oppian has it Trigla it is only to preserve the measure of the verse" (B. i., v. 590 compared with v. 105); but there can be no doubt that under this name they have confounded together two species, of which the more common in the Mediterranean is the Red Mullet—*Mullus ruber,* while the Surmullet, *M. surmuletus,* is the common species in England; to which therefore my own observations will more strictly apply.

It was an ancient supposition of the fishermen of Greece that this Mullet was in the habit of shedding its roe three times in the year, from which circumstance it was that it obtained its name. In his inquiries into the nature of fishes, Aristotle could not fail to examine the supposed circumstances that had led to this conclusion; and, accordingly, he records the substance of what he had been told; but it appears it was with some hesitation of belief, for he adds, that as some proof of the fact, it had been noticed the very young ones of this species were accustomed to make their appearance, with distinct intervals, three times in the year: but in another book of his work on the nature of animals, this great philosopher further observes that the Mullet was accustomed to deposit its roe in the autumn, as if that were the only season of which he could feel any certainty; and it is highly probable that his thoughts on this and kindred subjects, as obtained from fishermen, were such as afterwards were expressed by the poet Oppian in his Halieutics (B. i.) —that while hunters and birdcatchers have opportunities of closely studying the actions and manners of the creatures they pursue,

> "Fish in the sea the circ'ling eddies hide,
> And through the trackless deep unseen they sportive glide.
> And ah! how great the task! for who can know
> What creatures swim in secret depths below?
> Unnumber'd shoals glide through the cold abyss
> Unseen, and wanton in unenvied bliss.
> For who with all his skill can certain teach,
> How deep the sea—how far the waters reach?"

It does not appear to have entered into the minds of ancient observers, that even if the remarks referred to had been correct, in reference to the threefold appearance of the young of this fish, it may have proceeded from the spawning of different individuals, or of such as were of different ages or districts, as will happen also in fishes of other races. But the authority of Aristotle, as well as popular belief, was ever so great that what he had recorded was

copied by Pliny (B. ix., c. 30); and yet with the addition of the remark, that, at least, the young of this fish are accustomed to make their appearance with three separate intervals; as if he felt it necessary to couple the doubt with the observation. However, as a fact, it is again, although in a very brief manner, referred to by Oppian, and in more modern times by Belon and Rondeletius; both of whom appear to speak only from tradition, or by copying the more ancient authors. It remains for us to make inquiry in nature itself, whether there be any, and what authority for this belief; and also what are truly the habits of these fishes in reference to some other particulars reported of them by the ancient writers already referred to.

The Red Mullet of the Mediterranean is too rarely found on our coast for me to be able to ascertain the exact time at which its spawn is shed; but the Surmullet with us is known to perform this function about the middle of the summer: and I am informed by an intelligent fisherman, who is accustomed to send these fish for sale to London, that in July, in preparing them for the journey, the spawn will often escape from their body. The adult fish thus caught are near the land, and the young ones soon appear, and are of rapid growth; for early in September they are found of from one to two inches in length: at which time, perhaps, from their colour, they bear the name of strawberries. But they are not in equal abundance every year, although in some respects a degree of regularity is observed in their seasons of abundance and scarceness; for although the roe is shed in every year, a considerable abundance of the young is only met with every second or third year; and it is only in the season next following this that a large supply of the fully grown examples are obtained. In looking back for a space of ten years, the abundant season of very small Surmullets or strawberries, has thus occurred only thrice in ten years. Later in September these fish are taken with a line in our harbours; and soon afterwards, that is, early in October, they all leave the coast to pass the winter in deep water. It may be too much to suppose, that the appearance of the young Mullets three times in a year, as was said to be observed by the Greek fishermen, was a mistake for their appearance in large numbers once in three years.

As regards the food of this fish, it is familiarly known that it will take the hook baited with the worm, and also that it seeks its food at the bottom; and its method of obtaining it, as observed and related to me by my excellent friend already referred to, is highly curious. His attention was particularly drawn to four of these fish,

which, in rather shallow and clear water, were seeking food on the sand close to a ledge of rocks; but where they were busiest the ground looked dark, and as if worms had been at work in throwing it up into small heaps. At this place these fish were actively engaged in employing their barbs as if they had been hands, so as to uncover whatever of their prey might lie beneath; and, therefore, we should not think it strange if we find in their stomachs the smaller crustacean and other animals which have their home in such situations. The muscular and nervous structure of these parts is well worthy of notice.

It is probable that Ælian does no more than repeat a popular rumour (B. ii., c. 41), when he says that the Triglè is the most voracious of all the inhabitants of the sea; so that nothing comes amiss to it at any time, and that it feeds even on the carcases of shipwrecked sailors as well as on fish; so that it is especially eager after what has become putrid. But he seems to make exception in favour of some, whatever they are, that were termed Leprodes; which name they bore—not because their scales were rough, but from the places they frequented, and where they fed on very small seaweeds. This author is not to be regarded as an authority in natural history; but rather as a gatherer of opinions and reports that floated on the surface of society; and an inspection of the jaws of the Surmullet will assure us that this charge of cannibalism must be without foundation. Yet the following verses will show that it was believed by Oppian, and probably by the public at large:

"Of all the kinds that range the spacious flood,
The luscious Triglè seeks the coarsest food;
In beds of slime they roll with wanton ease,
And cull the grossest ordure of the seas.
But shipwreck'd men, detested sights of woe,
The richest course of luxury bestow.
Whatever baits a nauseous smell diffuse
With sure success commend their constant use.
Swine and the Triglè seem alike inclined,
Mean is their choice, their palates unrefined,
But none that yield a more delicious food,
Or haunt the forest or divide the flood."—B. iii.

In answer to this it is sufficient to observe that by Aristotle we are informed that these fishes are not to be accounted carnivorous. It appears from Ælian, B. ix., c. 51, that this Triglè was regarded as sacred in the Eleusinian mysteries; the reason for which was by the uninitiated supposed to be, that it produced its young three times

in the year, or that it devoured an animal then as now termed the sea-hare—Lagos; a kind of mollusk that was believed to be a poison to man. It is probable that there was some other reason, equally fanciful or superstitious, and equally false, for neither the priests of Ceres or Proserpine, nor the priestess of Juno would suffer the Triglè to come near their lips; whilst, notwithstanding the supposed danger, the sea-hare was sometimes used as food. It must also be remembered that there were other sacred fishes, to which the supposed characters of the Surmullet did not apply.

THE ORIGIN OF MINUTE LIFE.

BY HENRY J. SLACK, F.G.S., SEC. R.M.S.

CONTROVERSIES about "spontaneous generation" ought in these days to be replaced by inquiries into the conditions under which organisms of a low character can exist, or become developed. "Spontaneous generation" is a bad term, involving a metaphysical idea not properly belonging to physical science, or to biological science either. The term would indicate that something is generated of its own accord—a notion barely intelligible, and bordering upon absurdity. What one set of investigators meant by it was, that, under certain circumstances, physical and chemical forces aggregated inorganic matter in such a way as to produce organic matter, or an organized being, which had no connection of hereditary descent with previously existing beings of the same species, or of any species whatever. Were it desirable to investigate this belief in an accurate manner, we should have to consider what various writers meant by physical and chemical forces; and by "nature," which was supposed to call them into action, and whether those terms were made to include what vitalists would call vital powers. The notion of life arising from a fortuitous concourse of atoms is an absurdity not contained in any speculations to which we need now pay attention, but there are two schools whose theories continue to exert a practical influence upon experimental inquiries and methods of reasoning. The one, in the words of Pouchet, affirms that, "under the influence of forces still unexplained, and, as Cabanis says, which will remain truly inexplicable, either in animals themselves or elsewhere, there is a manifestation of a plastic force which tends to group molecules together, and impose upon them a special mode of vitality, from which results a new being, corresponding with the medium in

which its elements were primitively drawn together (*puiser*)."* This plastic force is much like the "vital force" of a recent school of physiologists, but I do not understand where M. Pouchet supposes it to reside; but, however that may be, he says that it does not create an adult being, but operates in the same way as sexual generation.

The second school, at present of importance, adopts the idea of Otho Frederick Müller, cited by Pouchet, to the effect that animals and vegetables decompose into organic particles endowed with vitality, and capable of developing as germs. Pouchet also quotes J. Müller as admitting a spontaneous generation, which is only the result of the decomposition of large organisms, whose molecules, dissociating themselves, become animalcules.

A few years ago, Mr. H. J. Clark, of Cambridge, U. S., communicated a paper to the American Academy, which I find published in the "Annual of Scientific Discovery for 1860," in which he states, that a portion of the muscle of a Sagitta in a decomposing state formed vibrios out of its separating fibrillæ. He said that "what would be declared by competent authority to be a living being, and accounted a species of vibrio, is nothing but dead muscle." I have often observed, when soft creatures like freshwater worms, or large infusoria, break up, that some of their molecules behave very much like living beings, but appearances of this description do not give much help in settling the question. Vibrio-like things may result from a physical coalescence of particles, and move by some force quite distinct from vital. Unless they can be *proved* to perform some vital action, it may be unwise to conclude too positively that they are alive.

The experiments of Dr. Montgomery with myeline show how readily certain objects comport themselves like organic cells, although they are really nothing of the kind. To obtain myeline, the yolk of an egg is boiled with about one ounce of alcohol; the liquid is filtered, and the sediment, myeline, collected. Dr. Montgomery states,† that the least particle of this myeline sediment will exhibit under the microscope, with the addition of water, the curious spectacle of tubes shooting forth, and wriggling about. When mixed with white of egg, bright globules formed instead of tubes. Very dilute nitric acid, added to the above, coagulated the albumen in the artificial cell, and gave the appearance of mucous nuclei. Blood serum answered

* "Heterogenie," pp. 7, 8.

† "On the Formation of so-called Cells in Animal Bodies," by Edmund Montgomery, M.D., late Demonstrator of Morbid Anatomy at St. Thomas's Hospital. Churchill.

better, and the resulting artificial cells are described as resembling corpuscles of saliva. In other experiments various cell appearances were obtained, including those multiplications by division. I have nothing to do with Dr. Montgomery's reasonings upon these experiments; I adduce them simply for the purpose of showing that things which are not alive may, from physical agencies, go through a series of performances that might easily cause them to be taken for living beings, or for organic units, if that term be preferred, which is, perhaps, advisable.

When a microscopist has to deal with objects of very minute size, it is clear that, unless great caution is used, he may ascribe life to them without sufficient reasons. Even with objects as large as Dr. Montgomery's cells, deceptive appearances would be very likely to mislead. An observer might see a mother cell give rise to daughter cells, and forthwith pronounce them alive. He tells us of "the most splendid examples of 'cells,' in all stages of fissiparous division," resulting from the processes above described. In cases of true living cells, the physical results of absorption of water, or other fluid, the mechanical enlargement of the plastic material, fission, etc., probably takes place in simple accordance with natural laws. The old notions that life controlled and modified chemical and physical laws is exploded by the progress of discovery, especially in organic chemistry, and there is strong evidence that organic substances are formed in living bodies exactly in the same way as the chemist can imitate many of them in his laboratory, although his apparatus is very inferior to that which nature employs.

We conclude a simple plant like the yeast-cell to be truly alive, because it not only changes the food-matter with which it comes into contact, but assimilates it, and passes through a real growth. In Dr. Montgomery's experiments his particles of myeline did not transform any adjacent matter. They absorbed water, which enlarged them, and they exhibited purely physical change, varied according to the viscidity or limpidity of the fluids surrounding them. In this there was nothing truly resembling life, though the process may be identical with *some* of the processes which living cells exhibit. When we come to consider what we mean by calling a simple cell *alive*, we have to discard all the higher conceptions of life, as it exists in animals, or in man. The yeast-plant, for example, consists of little bladders or cells, containing a substance in which nitrogen figures as a constituent. It takes in surrounding matter, it appropriates it, works a chemical change in it, enlarges itself, and makes offspring, or buds, with one portion of the material, and leaves the

rest as the alcohol and carbonic acid which result from fermentation. The chemist can trace the nature of these operations, which differ from his own experiments chiefly in this, that the yeast-plant, which is a chemical apparatus for transforming sugar according to a definite formula, reproduces itself, and gives rise to a numerous progeny, all capable of doing the same work. But the yeast-plant is only one of a series of forms capable of acting as ferments, though not limited to the alcoholic kind.

Smaller than the yeast-plant, and the blue moulds, and other forms which belong to the same series, and are more or less convertible one into the other, are the vibrions, bacteriums, and similar organisms. The vibrions are, as most of my readers know, minute beaded chains, more or less spiral, from about 1—430″ to 1—9200, or less, in length, and of proportionate tenuity. Bacteriums are stiff, rod-like bodies, equally, and more minute; and spirillum is an elegant and very delicate helix, moving with a beautiful screw motion. Many microscopists, especially in France, call these things, or most of them, *animals*, but they are probably either vegetable, or should be arranged in a group by themselves. Little regard can be paid to divisions of them into *species*, if by that is meant that their offspring will always resemble their parents, but distinct forms have specific powers as ferments. When organic matter is decomposed under ordinary conditions, some of these organisms invariably appear, and they seem to act as the chief agents of the chemical changes that occur. By what means they move is not known. Dujardin and Ehrenberg have ascribed locomotive filaments to some of them, but I have never seen anything of the kind, and conjecture their motions are the consequence of actions of endosmose, exosmose, and contraction and expansion, arising therefrom.

Minute objects of this kind are usually the subjects of discussion when the spontaneous generation controversy crops up, and from their extreme smallness, and the facility with which they appear, it is very difficult to trace either their structure or their origin. A single cell is probably capable of producing them, and that may be so small, that a negative decision as to its existence in any fluid or solid cannot be worth much, except we can satisfy ourselves that we have rendered all life impossible in the *substance* to which reference is made.

M. Pouchet is now the leader of those whom it is the custom in England to call "Spontaneous Generationists," but that term is incorrectly applied to him and to his colleagues, MM. Jolly, Musset, and others. Pouchet adopts the term, "heterogenesis," which, as we have shown, he describes as a method of generation differing from

that by means of eggs, or buds, and yet in affinity with it. As an account of Pouchet's theories was given in the "Intellectual Observer," vol. i., p. 85, I need not now describe it at length, but shall advert to one or two points. He says, "If, in our experiments, proto-organisms develope themselves by contact of divers bodies, we must not suppose the cause of their appearance is absolutely under the influence of affinities; this would be to lower creation to the level of chemical attraction;" and he goes on to profess his agreement with Bremser, who alleges "spirit" to be the principal cause of life, which he declares does not arise from such a mingling of substances as the chemist can produce. Pouchet considers that it is "an immense error to regard reproduction as an act accomplished by the mother." The mother, he says, does not make the egg, which he supposes to be animated with a "vital force" of its own from the moment its two first molecules come together. He considers that fermentations and putrefactions "disengage organic molecules," and prepare the way for fresh combinations. First, he says, may be noticed in infusions a pellicle, which grows thicker, and becomes what he calls the "prolific pellicle." It is, he says, composed of the remains of animalcules, and acts as an improvised ovary, in which others are generated. At first, organizable matter in infusions, according to his views, in a state of solution, but in the course of fifteen or twenty hours, at a sufficient temperature, and under the influence of air, minute corpuscles appear, at first motionless, but afterwards moving in a way that distinguishes them from inorganic particles in molecular motion; they are, he says, monads of the smallest kinds.

Passing from theories of heterogenesis to experiments, the thing to be ascertained is whether any bodies possessing organic life, vegetable or animal, are produced in solutions or fluids in which all germs have been destroyed, and from which they are excluded. The opponents of heterogeny and similar hypotheses, explain the appearance of animalcules in solutions exposed to the air, by referring them to germs, or eggs, floating about in the atmosphere, and ready for development if they fall under suitable conditions. M. Pouchet calls those who hold this view "Panspermists," and challenges them to prove the existence of the quantity of diffused germs their theory requires. He likewise continues, year after year, to adduce experiments in which Infusoria appear, although the fluids in which they occur have been boiled, and the only air admitted has been passed through red-hot tubes, or sulphuric acid. In another class of his experiments he obtains special growths

under special conditions, and asks if we can believe that the air contains a great variety of germs capable of such varied development. He affirms that, "by varying to infinity the solid substance of an Infusoria, where the same air and water are used, the Infusoria will equally vary infinitely as the character of the solution varies." This may be tested by any microscopist, and I think the result will scarcely correspond with the very wide assertions M. Pouchet makes. One of his experiments in free air is a very pretty one, from his description, but I cannot speak of it from my own experience. He places some paste, made with wheat flour and boiling water, in a flat porcelain trough, so as to form a layer about one centimetre thick. When the paste begins to solidify, he traces letters on it with a brush, dipped in a strong infusion of galls which has been filtered. He covers the vessel over with a plate of glass, and in four days finds the letters in *black*, composed of a microscopic fungus he calls *Aspergillus primigenius*. He tells us that only where the infusion of galls has acted do any organisms appear.

In opposition to a multitude of experiments by M. Pouchet and his companions, MM. Joly, Musset, etc., M. Pasteur adduces a quantity of his own experiments, the result of which is to show that if organisms and germs are destroyed by boiling, and the vessels sealed, or only allowed access to air deprived of germs, no life of any kind appears. M. Pasteur's experiments have been usually regarded as conclusive in this country, and they certainly seem to be more exact than most of those adduced on the other side; but he does not use high powers with his microscope, and it is difficult to reject counter experiments which are alleged to have yielded opposite results, and to have been made with equal care.

Among the most noteworthy of these experiments are those which Dr. Gilbert W. Child has brought before the Royal Society, and which are collected together, with some additional matter, in a volume just published.* Dr. Child's first set of experiments were made with milk, and fragments of meat and water, placed in glass bulbs about two inches and a half in diameter, and having two narrow and long necks. "In one series the bulbs were filled with air previously passed through a porcelain tube containing fragments of pumice-stone, and heated to vivid redness in a furnace. In the others they were respectively filled with carbonic acid, hydrogen, oxygen, and nitrogen gases." The matter in some bulbs was boiled, and in others not. The joints of the

* "Essays on Physiological Subjects." By Gilbert W. Child, M.D., F.L.S., F.C.S., of Exeter College, Oxford. Longmans.

apparatus were formed by nonvulcanized india-rubber tubing and india-rubber corks, previously boiled in a solution of potash. In every case but one, in which the substances had not been boiled, low organisms were found, and the bulb in which these were not seen burst from some fermentation, probably associated with life. In the boiled bulbs, no sign of life appeared in those filled with carbonic acid, or in those filled with hydrogen; but organisms did appear in that filled with the heated air, and in the milk bulb filled with oxygen. The oxygen and meat bulb burst spontaneously.

In another set of experiments Dr. Child used a porcelain tube partly filled with grounded pumice, one end being connected with a gasholder, and the other with the bulb holding the putrescible matter. The bulbs had two necks as before, one connected by means of an india-rubber cork with the porcelain tube, and the other bent and inserted in sulphuric acid. "The central part of the tube containing the pumice was heated red hot by a furnace, the bulb joined to it when it attained a vivid heat; the end of the porcelain tube which projects from the furnace being made thoroughly hot immediately before the cork is inserted, the cork itself being taken out of boiling water, and the neck of the bulb heated in a spirit-lamp immediately before it is inserted into the cork." A stream of heated air was passed through the apparatus, and the bulb boiled for ten or fifteen minutes. When cool the bulb was sealed. Peameal, hay, coarse flour, sage-leaves, and celery were the substances employed for the infusion; and Dr. Lionel Beale was present when some of them were examined on September 9. Small organisms were found in a bulb filled May 18 with peameal and water, and also in another filled with hay-water on July 18, and in a similar bulb filled the same day. Some dumb-bell crystals were also seen. In another bulb the result was "unsatisfactory;" even with high powers no certain evidence could be obtained, as was the case in other instances when "minute round spore-like bodies were seen moving about the field." Other series of experiments were undertaken.

Dr. Childs says, "Now, if we omit from these two series of experiments those which I have already shown reason to distrust, we have in all, seven in the first, and six in the second series, which seem fairly to test the question; and these having been examined by Dr. Beale as well as myself, bacteriums were found and seen by both of us in three out of the first seven, and five out of the remaining six."

Dr. Childs ascribes the discrepancy between his results and those of M. Pasteur to the fact of his having employed high powers,

Ross's one-twelfth and Lealand's one-twenty-fifth; while the French chemist contented himself with a power of three hundred and fifty diameters, which is certainly very insufficient. I have paid considerable attention to the exhibition of minute-headed structures in investigations of various kinds, and I have found the most delicate can only be rendered visible by powers double, treble, and quadruple those used by Pasteur, and by very careful illumination. Further than this the eye must get accustomed to the objects, just as astronomers know is necessary in separating close double stars.

Dr. Childs states that the cloudy appearance of a fluid is no indication of its containing bacteriums, or the reverse. He has now "no doubt of the fact that bacteriums can be produced in hermetically-sealed vessels containing an infusion of organic matter, whether animal or vegetable, though supplied only with air passed through a red-hot tube, with all necessary precautions for ensuring the thorough heating of every portion, and though the infusion itself be thoroughly boiled. But how far this affects the question of spontaneous generation is quite another matter." It seems, as Dr. Childs says, that either the germs of bacterium can resist boiling water, that they are spontaneously generated, or that they are not organisms at all. The last he rejects, and there remain the two former, on which he does not decide.

Dr. Childs cites some similar experiments of Dr. Wyman, "in which organisms certainly appeared under the same circumstances as they did in his own, and as they never did in M. Pasteur's; yet if the infusion were boiled for six hours no organisms ever appeared." This looks as if the germs were only destructible by prolonged boiling, but it does *prove* all that is wanted. M. Lemaire ha shown "that the mere fact of an infusion being enclosed within a hermetically-sealed vessel, even without any application of heat, is in itself sufficient to check the production of organisms, for in such circumstances fermentation begins, but cannot continue." I have observed that if a small piece of organic matter is placed on Professor Smith's growing cell, and covered with thin glass pressed close upon it, though bacteriums appear, they soon die, and do not propagate.

My object in this paper is neither to advocate nor to oppose any theory, but simply to show what experimenters are doing on the subject, and what are their results.

It seems difficult to account for a large class of Pouchet's facts, upon the supposition that organic germs abound in the air, without ascribing to them a far greater minuteness than has hitherto been

supposed, and without also presuming that the germs of simple organisms are capable of being developed into whole groups of organisms, commonly reckoned as distinct species. In one passage Pouchet says that air would be as heavy as lead if it contained all the germs the panspermists suppose; and if the phraseology be a little exaggerated, we ought not to discard too summarily the reasoning on which it is based.

M. Pasteur has collected, by means of an aspirator, the minute particles floating in the air, and entangled them in a tuft of gun cotton, which, being dissolved, left them behind, and he raised a crop of organisms from the germs the air contained. These objects were distinguishable with the low powers he employed; but who shall say what is the smallest germ, or what portion of a minute globule to which that name is assigned is the real germ? The question of the size of germs is not altogether unconnected with that of their destruction by heat or acids. Probably the germ of a higher animal or vegetable is a highly complex structure; in fact, a congeries of simple germs arranged in a definite manner. This may be accepted whether Darwin's remarkable theory be correct or not, and heat, or the action of an acid like sulphuric, abstracting water, may destroy the vitality of a compound germ by dispersing the particles, taking away their freedom of motion, or altering the order in which they are arranged. A single germ may be far more indestructible, and may survive a temperature or the action of a re-agent that would be quickly fatal to a complex germ.

Important discoveries always cause a surprise, except to a few minds who have had some prevision of them. To ordinary mortals that which seemed impossible is very likely to be true, and although the mystery of life will probably remain inscrutable, honest researches into the origin of minute forms are sure to reveal striking and unexpected truths. I therefore recommend English observers to enter upon their investigation without compromising themselves by adopting theories upon insufficient grounds.

ASTRONOMICAL NOTES FOR DECEMBER.

BY W. T. LYNN, B.A., F.R.A.S.

Of the Royal Observatory, Greenwich.

MARS and Jupiter will be the only planets visible in the evening during this month.

MARS rises on the first day at 10h. 4m. P.M., and on the last day at 8h. 32m. His place in the heavens will be in the constellation Leo, and he will be in conjunction with the Moon on the evening of the 5th. On the 14th his distance from us will be exactly the same as that of the Sun, and he will not approach very near us at any time during the present return to opposition.

JUPITER sets at the beginning of the month about a quarter before two in the morning, and at the end of it a few minutes before midnight. He will be on the meridian at seven o'clock on the evening of the 10th, and at six o'clock on that of the 26th. He continues in the constellation Pisces, and will be near the Moon on the nights of the 21st and 22nd.

PHENOMENA OF JUPITER'S SATELLITES.—The following is a table of those phenomena of the satellites which will be visible before midnight in December. Mr. Proctor's paper in the October number of THE STUDENT, will have given renewed interest to the observation of these bodies.

DATE.	SATELLITE.	PHENOMENON.	MEAN TIME.
			h. m.
December 2 ...	I.........	Transit, ingress	9 32
" 2 ...	II.........	Occultation, disappearance ...	11 0
" 2 ...	I.........	Transit, egress	11 47
" 3 ...	I.........	Occultation, disappearance ...	6 48
" 3 ...	I.........	Eclipse, reappearance	10 16
" 4 ...	II.........	Transit, ingress	5 52
" 4 ...	I.........	Transit, egress	6 15
" 4 ...	II.........	Transit, egress	8 25
" 6 ...	II.........	Eclipse, reappearance	5 13
" 6 ...	III.........	Transit, egress	7 16
" 9 ...	I.........	Transit, ingress	11 23
" 10 ...	I.........	Occultation, disappearance ...	8 41
" 11 ...	I.........	Transit, ingress	5 52
" 11 ...	I.........	Transit, egress	8 7
" 11 ...	II.........	Transit, ingress	8 25

DATE.	SATELLITE.	PHENOMENON.	MEAN TIME.
			h. m.
December 11 ...	II.........	Transit, egress	10 58
„ 12 ...	I.........	Eclipse, reappearance	6 41
„ 13 ...	II.........	Occultation, reappearance ...	5 18
„ 13 ...	II.........	Eclipse, disappearance	5 28
„ 13 ...	II.........	Eclipse, reappearance	7 49
„ 13 ...	III.........	Transit, ingress	8 11
„ 13 ...	III.........	Transit, egress	11 8
„ 17 ...	III.........	Eclipse, reappearance	6 6
„ 17 ...	I.........	Occultation, disappearance ...	10 35
„ 18 ...	I.........	Transit, ingress	7 45
„ 18 ...	I.........	Transit, egress	10 1
„ 18 ...	II.........	Transit, ingress	11 0
„ 19 ...	I.........	Occultation, disappearance ...	5 4
„ 19 ...	I.........	Eclipse, reappearance	8 37
„ 20 ...	II.........	Occultation, disappearance ...	5 18
„ 20 ...	II.........	Occultation, reappearance ...	7 52
„ 20 ...	II.........	Eclipse, disappearance	8 4
„ 20 ...	II.........	Eclipse, reappearance	10 26
„ 24 ...	III.........	Occultation, reappearance ...	4 56
„ 24 ...	III.........	Eclipse, disappearance	7 42
„ 24 ...	III.........	Eclipse, reappearance	10 8
„ 25 ...	I.........	Transit, ingress	9 40
„ 26 ...	I.........	Occultation, disappearance ...	6 59
„ 26 ...	I.........	Eclipse, reappearance	10 33
„ 27 ...	I.........	Transit, egress	6 24
„ 27 ...	II.........	Occultation, disappearance ...	7 54
„ 27 ...	II.........	Occultation, reappearance ...	10 28
„ 27 ...	II.........	Eclipse, disappearance	10 41
„ 28 ...	I.........	Eclipse, reappearance	5 1
„ 29 ...	II.........	Transit, egress	5 31
„ 31 ...	III.........	Occultation, disappearance ...	6 1
„ 31 ...	III.........	Occultation, reappearance ...	9 0

The eclipses take place on the right hand side of the planet, as seen in an inverting telescope. The disappearances of the first satellite at eclipse are not visible; its reappearances take place at the distance of about half a diameter of Jupiter from him. The second satellite disappears at eclipse very close to the planet, and reappears at the distance of about a diameter from him. The third satellite disappears about half a diameter, and reappears about a diameter of Jupiter from the planet. No eclipse or other phenomenon of the fourth satellite will take place.

Occultations of Stars by the Moon.—Three of these occur within convenient hours :—

DATE.	STAR.	MAG.	DISAPPEARANCE.		REAPPEARANCE.	
			MEAN TIME.	V.	MEAN TIME.	V.
			h. m.	°	h. m.	°
Dec. 3	d^2 Cancri	6	8 13	47	9 5	231
„ 27	Bradley, No. 686	6	6 27	34	7 22	283
„ 30	ζ Cancri	$5\frac{1}{2}$	11 44	22	12 42	286

THE MOON.—Again we have only space to give the times of her phases:—Last Quarter, on the 6th, at 9h. 34m. P.M.; New Moon on the 14th, at 1h. 33m. A.M.; First Quarter on the 22nd, at 4h. 28m. A.M; Full Moon on the 29th, at 1h. 48m. P.M. Observations of the objects under the terminator may therefore commence about the 17th.

NEW PLANET.—On the 10th of October, Professor Watson, of Ann Arbor, Michigan, added another to his list of discoveries, by detecting No. 106 of the large group of Minor Planets.

THE DOUBLE COMET OF 1860.—This comet, which was discovered and observed by M. Liais, and seen by him alone, in Brazil, presented a remarkable analogy to Biela's Comet, in that it consisted of two distinct parts. Unlike the latter, however, at the time it was seen to separate in 1846, the one part of the double comet of 1860 was unmistakably the principal body, and the other a smaller companion. At the recommendation of Professor D'Arrest, Herr Pechüle, of Copenhagen, has recently investigated the orbit or rather orbits of this comet, and his conclusions,* we think, deserve mention here.

From the appearances observed in double comets, hopes have been entertained that some increase in our knowledge of the nature and constitution of comets generally might be derived. Unfortunately the observations of Comet I. 1860, which were made entirely by M. Liais, at Olinda, in the Brazils, extended over a period of only little more than a fortnight (from February 26th to March 13th), and, of the whole seven nights on which it was observed, on three only was it possible to assign at all accurately the relative places of the companion comet. Herr Pechüle has determined, as satisfactorily as the data admitted, and more completely than had previously been done by Liais himself and by Pape, a parabolic orbit for the principal body. The inclination of that orbit to the

* "Astronomische Nachrichten," No 1719.

ecliptic is nearly 80°, and the perihelion distance from the sun 1·2 times that of the earth's mean distance. The comet's motion was direct, and the time of perihelion passage 1860, February 16th. In his investigations into the motions of the little companion comet, Pechüle has had no predecessor. The only practicable way to treat it was, from the differences of right ascension and declination between it and the larger body, as determined by M. Liais on three nights (February 27th, March 3rd and 10th), to calculate an orbit for the former also. It thus appeared that its distance from the other was almost constant, and was about 230,000 miles, or rather less than the Moon's distance from the earth.

It may interest the reader to refer him to M. Liais' account of the appearance of this comet, or rather of these comets. He states* that he was frequently in the habit of surveying the region of the sky in the neighbourhood of the southern pole, to see whether any comet might thus be discovered which was not visible in Europe, and that on the night of the 26th of February, he perceived, near μ Doradûs, a nebulosity which he had never noticed there before. Comparison with that star soon showed that the nebulosity in question was a comet. "By the side of the principal nebulosity, there was a second, smaller and fainter, which I soon found followed the motion of the first. The comet presents therefore the singular aspect of two distinct nebulosities." He goes on to describe the appearance of each :—"The larger nebulosity, which first enters the field of view, has a form elongated sensibly in the direction of the radius vector. It is most brilliant also on the side turned towards the Sun, and presents near the extremity on that side a small luminous point comparable in brightness to a star of the ninth magnitude. The amount of light is very feeble, and the observations are difficult owing to the impossibility of conveniently illuminating the field of view without losing sight of the comet. So that it has not been possible to measure the size of the nebulosity, it being very confused and the boundaries very ill-defined. I estimated, however, its longest diameter at from twenty-five to thirty seconds, and the shortest at from seven to eight seconds. On the 27th, at 10h. 25m., the second nebulosity followed the first by twenty-seven seconds of time at a less southern declination by 1′ 8″. These measures, which are a little uncertain, on account of the feebleness of the light of the second nebulosity, refer as near as may be to the brilliant point in the first, and the centre of the second. The second nebulosity appears nearly circular, and in

* "Astronomische Nachrichten," vol. lii. p. 379.

diameter about equal to half the breadth of the first, that is, about four seconds."

Distance of the Sun.—In the last number of The Student we mentioned that Mr. Stone had at last unravelled, in the most satisfactory manner, the mystery which has for some years past been a standing reproach to astronomy, viz., that the distance of the Sun, as derived from the transit of Venus in 1769, differed by nearly four millions of miles from that determined by the observations of Mars during its favourable opposition of 1862. The matter being of the greatest interest and importance, we propose now to show in some detail how it is that Mr. Stone has made it manifest that the results derivable from these two sources are, when the observations of Venus are *justly interpreted* and accurately reduced, in reality beautifully accordant, so that the true value of the sun's parallax, and consequently that of his distance, may now be considered as known within very small limits of error.

It is well known that the investigation of the observations of the transit of Venus, which has hitherto been principally relied upon, is that of the late Professor Encke of Berlin. The value of the equatorial horizontal parallax of the Sun, obtained by him, was $8''\cdot5776$. Don José Joaquin de Ferrer had also obtained a value practically the same as this (for no one ever attached much weight to the last two decimals), namely $8''\cdot58$, which he affirmed could not possibly be affected with an error greater than $0''\cdot03$.

Now the observation is, as we stated in a note in our last paper on the subject, one of considerable complexity. This is owing to the effects of the irradiation of the Sun's light, as the dark body of the planet passes on and off his bright and intensely luminous disc. The observers of the transit of 1769 used different terms in describing the appearances seen, and in recording what they took to be the times of ingress and egress, did not refer them to the same phase of the phenomenon. Hence the necessity of carefully and properly separating their observations, "without which," as Mr. Stone remarks, "no reliance can of course be placed upon any result obtained." The data without this discrimination "are in fact inconsistent, and nothing but confusion could result" from any mathematical treatment of them. Yet this is what his predecessors had done. But Mr. Stone, after carefully distinguishing exactly what it was that each observer really did observe, finds that all the observations give results extremely accordant, and all are "in most satisfactory agreement with the values which have lately been otherwise obtained."

Of the whole of the observations, ten in number, which furnish the means of determining the duration of the planet's transit across the Sun's disc, two were made in Norway, two near Hudson's Bay, one in Lapland, three in California, and two at Otaheite.

The observations at Hudson's Bay* were made by W. Wales and J. Dymond. Their description of what they observed is particularly clear. "We took for the instant of the first internal contact the time when the last visible thread of light appeared behind the subsequent limb of Venus; but before that time Venus's limb appeared within that of the Sun, and his limb appeared behind hers in two very oblique points, seeming as if they would run together in a broad stream, like two drops of oil, but which nevertheless did not happen, but joined in a very fine thread, at some distance from the exterior limb of Venus. This appearance was much more considerable at the egress than at the ingress, owing, as we apprehend, to the bad state of the air at the time. We took for the instant of internal contact the time when the thread of light disappeared before the preceding limb of the planet, from which time W. W. took notice that he had told about twenty-four seconds when the limbs of the Sun and Venus were apparently in contact—a circumstance which he did not venture to attend to at the ingress." It is evident from this description that the times noted by Wales and Dymond were not, either at ingress or egress, those of internal contact of the limbs. The irradiation of the Sun's light around the planet diminished its apparent size when on his disc, so that, when it was just wholly on the disc at ingress, it appeared some distance within. For some time before that, it appeared to be connected with the Sun's limb by a black ligament, which decreased in thickness as the irradiated streams of light gained on each side upon the diminishing portion of the planet between them, until it was quite broken by a fine thread of light coming between the planet and the Sun's limb. So that the final separation of the planet from the limb was seen to take place several seconds after they were apparently in contact. At the egress, the same phenomena were observed in reverse order. When the limbs would really have been in contact had there been no irradiation, the planet seemed still some distance within the Sun's disc, but connected with it by a fine black thread or filament, which gradually thickened as the irradiated light gave way on both sides to the increasing portion of the dark body of the planet between. Wales

* At Fort Prince of Wales, on the north-west coast of the Bay.

made an estimation of the interval of time which elapsed between the formation of this thread and the apparent contact of the limbs. But the times noted both by Dymond and Wales were those of the breaking and formation of the black ligament, which connected the limbs of the Sun and planet after their apparent contact at the ingress, and before it at the egress, which were those when they would have been seen in contact, had it not been for the effects of irradiation.

The same kind of observation was made at Kola, in Lapland, by Herr Rumovsky. It was made, however, under unfavourable circumstances, and Mr. Stone (as Encke had also done) attributes less weight to it than to the other observations in finally deducing the solar parallax.

The observations at Wardhus, in Norway, were made under the direction of Father Hell, by himself and Father Sajnovics. They were not published till some time after they were made, and considerable suspicion (chiefly in consequence of this circumstance) has been thrown upon them, for which, however, Mr. Stone considers that there appears by no means to be any sufficient ground. At the ingress, it is stated by Father Hell that the contact of the limbs was observed. Yet both Encke and Ferrer took for granted that he meant the same phenomenon as that recorded by Wales and Dymond, when the Sun's light ceased to be visible between his limb and that of Venus, which, as we have seen, took place some time after the contact. At the egress, Hell states distinctly that Sajnovics and himself both observed the contact, and that, about thirteen seconds before he considered it to be certainly made ("certissimus contactus"), a sort of black drop ("aliqua gutta nigra") seemed to be formed between the limbs of the Sun and of Venus, which, six seconds afterwards, appeared to be much diminished in size ("minui valde"). Mr. Stone's interpretation, that the time noted at the ingress was that of the contact of the limbs, must, we think, be admitted as soon as pointed out, and will doubtless be generally accepted. The words used by Hell, at the ingress, are, "videtur contactus fieri," and six seconds after the time recorded for that, "contactus certus visus." Mr. Stone takes for the most probable time of apparent contact the mean of these two.

The Californian observations were made at St. Joseph, under the direction of M. Chappe. These are of a mixed kind. From Chappe's account, it is clear that, at the ingress, he observed not the apparent contact, but the same phenomenon as Wales and Dymond

at Hudson's Bay. He says,* "The edge of Venus's disc elongated itself as if it had been attracted by that of the Sun. I did not observe for the instant of total ingress that when the planet's limb began to elongate; but, as I could not doubt that this black point was a part of the opaque body of Venus, I observed the moment when it ceased, so that the total ingress cannot have taken place sooner, but may have been two or three seconds later. The black point was a little less dark than the rest of Venus." But at the egress, it would seem that Chappe did not catch the formation of the black drop, point, or connection which preceded the internal contact of the limbs of the Sun and Venus. His observation, therefore, is of the contact itself. He writes,† "At this first contact Venus has elongated herself more considerably than in the morning, coming quite suddenly close to the limb of the Sun." An assistant, however, M. Pauly, who observed the egress with the telescope used by Chappe (who now made use himself of one considerably larger) at the ingress, noted a time twenty-two seconds before that assigned by Chappe, and this was very probably that of the formation of the black drop, corresponding to Chappe's own observation at the ingress. No particulars are given of the observations of the two other observers at St. Joseph, Vicente Doz and Salvador Medina. They were with M. Chappe, and appear to have observed the same phases. Chappe never returned to Europe, as he died of the plague in California.

We have now only to consider the observations (the only ones made in the southern hemisphere‡) at Otaheite. They were made by Captain Cook and by Mr. Green. Dr. Solander also observed, but his observation was not complete. There is some difficulty in exactly understanding the phenomena observed by Cook and Green. They speak of a sort of penumbra, or half shadow, surrounding the body of the planet, which was supposed to arise from a sort of thick atmosphere. The observers at Hudson's Bay also speak of

* It is as well to give here the original French. "Le bord du disque de Vénus s'alongea, comme s'il etait attiré par le bord du Soleil. Je n'observai point pour l'instant de l'entreé totale, celui où le bord de Vénus commençait à s'alonger; mais, ne pouvant pas douter que ce point noir ne fît partie du corps opaque de Vénus, j'observai le moment où il était à sa fin; de façon que l'entreé totale ne peut être arrivée plutôt, mais peut-être plus tard de deux ou trois secondes. Le point noir était un peu moins obscur que le reste de Vénus."

† "A ce premier contact, Vénus s'est alongée plus considerablement que le matin, en s'approchant tout-à-coup du bord du Soleil."

‡ Two French astronomers, Véron and Bougainville, also sailed into the South Seas, with the view of making the observation on one of the Australasian Isles; but the day of transit came upon them when out of reach of land, so that it was impossible to carry out the object of their voyage.

looking for an atmosphere (as well as for a satellite of Venus), but perceived nothing like it. Now, as Cook states that the so-called penumbra was "nearly, if not quite, as dark as the planet," it appears more than probable that it was (in Mr. Stone's language) "nothing more or less than a part of the planet itself." Both Cook and Green give the times when, at ingress and egress, they considered both the real planet and what they call the penumbra were seen in contact with the Sun's limb. Encke, and other calculators, had interpreted the contact of the penumbra, at ingress and egress, to mean the breaking and formation of the black drop or extension which appeared to connect the limbs of Venus and the Sun for some time after (at ingress) and before (at egress) the contact of the limbs—the same phenomena, in fact, which were observed by Wales and Dymond at Hudson's Bay, and in part only by the observers at St. Joseph and Wardhus. But, from the figures drawn by Cook and Green to describe what they observed, Mr. Stone concludes (which he appears to be quite justified in doing) that this interpretation is erroneous. For they represented the penumbra as circular, and completely surrounding the planet. They explained it in accordance with their previously-formed belief in a visible gross atmosphere round Venus, and, if it did not, in fact, arise partly from that cause (which is possible), it must have proceeded from some optical effect quite different from that which caused the black drop or ligament, and the consequent distortion of form of the planet. Cook, moreover, tells us that the contact of the penumbra with the Sun's limb at the ingress was established gradually "with an uncertainty of several seconds;" and also that "at the egress the thread of light was not broken off or diminished at once, but gradually, with the same uncertainty: the time noted was when the thread of light was wholly broken by the penumbra." He also states that the darkness of the so-called penumbra was so great, that it was difficult to distinguish it from what he supposed to be the actual body of Venus, making the times noted for the contact of the latter very uncertain. Mr. Stone concludes that the times given by Cook and Green for the internal contacts of the penumbra with the Sun's limb were similar to those of the internal contacts of the limbs of the Sun and planet, as given by Fathers Hell and Sajnovics at both ingress and egress, and by the Californian observers at the egress.

After thus giving what there is every reason to believe to be the right interpretation of the observations, Mr. Stone proceeds* to

* "Monthly Notices of R. A. S.," vol. xxviii., p. 262.

form his equations of condition, and to reduce the whole ten, resulting from the ten observed durations of the transit, by the method of least squares. He thus finds that the Sun's horizontal parallax, determined by the transit of Venus, is $8''\cdot91$, or $0''\cdot33$ greater than the value found by Encke. His equations give him the means of calculating the interval between the apparent contact of the limbs and the breaking of the black drop at ingress, or its formation at egress. This interval, thus found, amounts to 16s.·6. Now, three of the observers have furnished the means of comparing this with observation. As stated above, Wales gave it as about 24s., Hell as 13s., and Pauly (compared with Chappe) as 22s. The mean of these is a little less than 20s., which must be considered a very satisfactory agreement with Mr. Stone's result. Finally, Mr. Stone compares the whole of the durations of the transit resulting from his equations with those determined by each individual observer. The residual errors are as follows:—

PLACE.	OBSERVER.	ERROR. SECONDS.
Hudson's Bay	Wales	+0·4.
Ditto.	Dymond	—0·6.
Kola	Rumovsky	—0·9.
Wardhus	Hell	—1·7.
Ditto	Sajnovics	+2·8.
St. Joseph	Chappe	+0·5.
Ditto	V. Doz	—0·4.
Ditto	Medina	—5·4.
Otaheite	Green	+5·8.
Ditto	Cook	—4·2.

It will be remarked that the largest discordance is only about 5s., quite within what might be expected from inevitable error of observation. But Encke's reduction, under his interpretations, made the Wardhus observations perfectly irreconcileable; the Kola observation more than 20s. discordant; Cook's, at Otaheite, nearly 16s. in error; and all those at St. Joseph considerably so. Whilst, therefore, Mr. Stone's interpretations are, *à priori*, the more natural, we cannot resist a feeling of extreme delight at the way in which they reconcile the whole of the observations, which now appear to be beautifully accordant. The greatest confidence must, we think, be placed in the resulting value of the Sun's parallax and distance, which may now be considered as satisfactorily determined quantities; and little impatience need now be felt for the future transits of Venus across the Sun's disc.

BEAUTIFUL TELESCOPIC FIELD.

BY THE REV. T. W. WEBB, F.R.A.S.

Before the object has passed too far towards the sunset, our readers may be directed to a very pleasing telescopic scene. Between *Wega* and *Albirro* (the well-known pairs in the beak of *Cygnus*), are two 3 mag. stars, β and γ *Lyræ*, of which β—worthy of notice as varying from 3 to 5 mag. by a very remarkable law of double maxima and minima—lies the nearer to *Wega*. A line from β through γ, bent somewhat to N., points out at a lesser distance 17 *Lyræ*, a 6 mag. star, with an 11 mag. companion 3″·6 distant, no bad test for a telescope, being very minute and delicate even with a 5½-inch achromatic. Rather more than 2° N. of 17, we shall easily find by sweeping with the large field of our lowest power, two pairs by a very rough estimate about 10′ apart. Each singly is a very pretty object, an 8 mag. star with a smaller companion; the colours appearing to me respectively yellowish and pale lilac, fainter yellow and pale blue; but the combination of the two in a field sprinkled with minuter points is very beautiful, and the whole effect not dissimilar to that of $\epsilon^1 4$ and $\epsilon^2 5$ *Lyræ*, on an expanded and enfeebled scale. It will well repay the trouble of finding.

CORRESPONDENCE.

NOTES OF THE SOLAR ECLIPSE OF AUGUST 18TH, 1868.

BY LIEUT. WARREN, HORSE ARTILLERY.

Being stationed at Bellary, only a few miles south of the southern limit of the path of the shadow of the eclipse of 18th August, I obtained three days' leave, and proceeded to a town called Adoni,* which is situated about forty-seven miles N.E. of Bellary. As nearly as it is possible to ascertain from the district map of the Survey Department, the latitude of Adoni is 15° 37′ N., and the longitude is 77° 20′ E. The central line of the shadow must have passed about sixty-three miles to the north of Adoni, and it was consequently just a few miles within the southern limit of totality.

Having no means of taking the times of the different contacts accurately, I confined myself to simply noting the general effects of the eclipse, including the variation in temperature. I took out my telescope

* We are not sure whether this name is Adoni or Adoui, our Correspondent's n's and u's being alike.

which is a 2¾-inch aperture, and I found the power of 50 the most useful. I also had a very good thermometer by Negretti and Zambra.

The early morning was clear and promised well, but it soon became cloudy and windy. As this is the rainy season of the year, great doubts had been entertained as to the probability of even getting a glimpse of the phenomenon, however, things turned out favourably in the end. The first contact took place about 8 A.M. At 8.10 A.M., the thermometer stood at 80° in the shade. At 8.35, having been looking through the telescope for some minutes, I noticed a great change on turning away from it, a kind of gloom had come over the country as if a great thunder-storm was at hand, and the degree of light was very sensibly diminished; the clouds were still passing over, and the wind was strong from W. During this time there were visible four spots on the south-eastern limb of the Sun, the two centre ones were adjoining each other and seemed very large, the lowest one was the smallest, I have tried to mark down their apparent positions and sizes as nearly as I could on the accompanying Fig. 1. A little before 9 A.M., the gloom was increasing rapidly and was indescribable. I could think of nothing that would give a satisfactory description of the kind of darkness: the rocky hills near me were in dark shades, yet each rock seemed distinct; the upper surfaces of objects were bright, whilst the lower and under parts were in very dark shade. Trees especially were noticed to appear of an intensely bright green on the tops, and the stems seemed intensely black. I watched the total obscuration of the Sun; but did not see any appearance of Baily's beads. The moment the last streak of light disappeared, the red protuberances burst forth into view, they were of a most beautiful pale rosy colour. Two only were visible where I was, the positions and apparent sizes and shapes of which I have marked in Fig. 2. I could make out the position of the conical one with the naked eye. Just before the total obscuration I noticed the sky to the westward looking much darker, and supposed it to be caused by the approaching shadow. Being situated so near the limit of the shadow, the total obscuration did not last long, probably about 2½ minutes, and during that time the darkness was not so very great; it was just possible to see to write with a pencil in the open air.

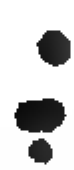

Fig. 1.

The appearance of the whole phenomenon at this time was very striking and very grand, the wind had dropped, and the clouds had cleared off, leaving an uninterrupted view, and there was the black disc of the Moon surrounded by the bright corona; the atmosphere was rather hazy and caused the corona to look rather ruddy. Venus and Mercury were distinctly visible, the former shone out with all her usual brilliancy; some stars may have been visible but I had only a moment to spare to look for them, and did not see any. The thermometer sank to 75·5°.

The Sun's reappearance was immediately preceded by a beautiful rim of pink light just at that part where he emerged. I did not observe Baily's beads at this time either, but noticed the rough and undulated appearance of the Moon's edge. A peculiar appearance that I saw just before the Sun was totally obscured, may be worth mentioning, on turning away from the telescope my eye was attracted by a peculiar shadow on the ground, it had the same rippling appearance as when smooth water is slightly disturbed by the wind, it struck me that it must have been caused by the haze passing over at the time. Again a decided duskiness in the sky was visible to the north of east, which was probably the shadow

Fig. 2. Fig. 3.

passing away. By 10 A.M., the sky was again cloudy, and the wind had risen. As the Moon was passing off I noticed another large spot on the Sun as in Fig. 3. and watched the other group of four spots successively reappear.

The only flowers near me were those of the prickly pear which closed up and opened out again. Whilst writing in the shade of the matting covering my cart, scores of small figures were thrown on the paper by the interstices of the matting, they were wonderfully distinct and well-defined.

There was great excitement among the native population, as the Brahmins tell them that the eclipse is caused by a dragon eating up the sun. The bazaars were all shut and there was great shouting and tom-toming, the natives did not eat or wash till it was over. The Brahmins I fancy made a good harvest out of them on the occasion. Some natives passing by me asked if the monster was letting go his bold of the Sun!

I append a table of the fall and rise of the thermometer during the eclipse.

TABLE SHOWING VARIATION OF TEMPERATURE DURING ECLIPSE.

A.M., 8.10	8.55	9.5	Middle	9.30	[illegible]	9.55	10.10	End.
80°	78°	77°	75·5°	76°	78°	80°	82°	88°

RANGE OF THERMOMETER DURING ECLIPSE, 12·5°.

PROGRESS OF INVENTION.

HATS, BONNETS, ETC.—An invention for the manufacture of hats, bonnets, etc., has been brought out by Mr. C. R. Broadbent, of Boston, U.S. The material which is employed is untanned skin or hide; by means of suitable dies, patterns can be stamped on the skin, hydraulic pressure being used. The hats are formed on blocks in the usual way, and may be stiffened or not with buckram treated with shellac. If the outer side of the skin be shown it may be stamped so as to imitate plaited straw; if the inner or flesh side, it is generally treated to represent felt. The hat, either before or after shaping, may be treated with tanning materials, and dyed to the required colour. The time required for the tanning process is about three hours. A solution of logwood may be used instead of nutgall to form the tanning liquid, it has the advantage of also serving the purpose of a dye. Hats left in the condition in which they come from the block—that is without stiffening—answer very well the same purposes as an ordinary felt hat.

APPARATUS FOR WATERING PLANTS IN POTS.—The following invention seems so simple, that it is hardly possible to conceive that it furnishes novelty sufficient to claim for it the protection of a patent. However, it has received the great seal, and, as it is useful, it is well to describe it. A hollow tube, made of metal, is employed. It is curved at the end, to allow the water readily to enter the flower-pot, and may be made of any length, provided the efficiency of the suction power of the syringe be not impaired thereby. It may be made to open and shut like a telescope. It is screwed or otherwise fastened to the end of a syringe, the rose ordinarily used having been previously removed. A small rose can be fitted to its curved end when required. Mr. Augustus F. Bayford, of 38, Hamilton Terrace, St. John's Wood, is the inventor.

SAVING LIFE FROM SHIPWRECK.—By means of this invention persons, when compelled to commit themselves to the water in case of shipwreck, may sustain themselves until they are rescued, and may be enabled to carry with them food and water sufficient to last them several days. It also includes a propelling, or swimming apparatus, ballasting shoes or weights, and a provision receptacle, and also an india-rubber suit, secured to the person of the wearer. The india-rubber suit is made in one piece, the lower parts or feet being thicker than the other parts, and in the same manner that india-rubber shoes are now made. The suit is made large enough to be put on over the ordinary clothing of the wearer, his shoes only being removed. The only openings in the suit are at the upper end or head, and at the wrists, for the exposure of the face and hands of the wearer. The openings at the wrists are provided with elastic cuffs, or bands, made in a piece with the suit, to confine the edges of the openings closely round the wrists of the wearer, so as to prevent

the entrance o water. To the under side of the edge of that part of the upper or top opening which comes upon the top of the wearer's head is secured a tubular elastic band, which passes under his chin. To the inner edge of the under side of the upper opening is attached an elastic band, which is buckled over the head of the wearer, and is prevented from slipping forward by an auxiliary band, which passes around the back of his head. The suit is secured to the body by a strap, fastened to the hinder part, and buckled. A cork vest or jacket is made by sewing two pieces of canvas, or other suitable material, together, and is stuffed with pulverized cork. The vest is worn beneath the india-rubber suit, and is buckled around the waist, and is prevented from slipping down by shoulder-straps. Metal shoes, or weights, fit upon the feet, the greater part of the weight (about five pounds) being collected upon the instep. The shoes are made in two parts, hinged to each other at the heel, for convenience in putting them on. The shoes should be lined or padded upon their inner side, to prevent them from chafing the wearer, and they should be galvanized, or wholly covered with india-rubber, to prevent the corrosive action of the water. The propelling, or swimming apparatus has a bar or handle, to be grasped in the hand of the wearer, and to the ends of which are attached wire bars and a wire framework, which is hinged or pivotted to the bars. This framework is covered with india-rubber fabric. When the hand with the propeller is moved through the water in one direction, the wings fold down, so as to encounter less resistance from it, but when moved through the water in the other direction they expand into a horizontal position, beyond which they are prevented from passing by a strap which passes beneath the hand or wrist, and the ends of which are attached to the outer edges of the wings. The floating provision receptacle is formed with two compartments, the lower or conical compartment is designed to contain water, which is poured in through a pipe, the upper projecting end of which is secured with a cap. The lower end of the smaller or drinking pipe extends down to near the bottom of the compartment, and to its upper end is attached a small flexible tube, terminating with a mouth piece, for convenience in drinking. The upper and larger compartment is designed to contain the provisions and signals, and is provided with an opening, covered and protected by a cap, by removing which access may be had to the interior. The inventors of this apparatus are John B. Stoner, Leopold Mendelson, and Theodore Crommelin, of New York.

FIRE-PLACES.—The loss of heat which is experienced in the use of an ordinary fire-grate, in spite of the improvements which have from time to time been introduced, still calls for the exercise of inventive genius. We do not quite like the idea of a closed stove, which is, without doubt, the most economical method of heating rooms; so that any invention which will save the present waste of fuel, and at the same time leave to us the cheering look of the fire, will be most welcome. Messrs. Charles

and Louis Verhulst, of Manchester, recommend that the fire-grate should be brought forward into the apartment, and that there should be applied to it a hood, to prevent the escape of smoke, and that this should be furnished with an improved valve, or damper, for regulating the orifice between the grate and the chimney. The whole fire-grate should be made to project beyond the line of the chimney-piece, so that the warmth may be distributed in the apartment more advantageously than is done by the present arrangement; and the hood should be constructed so as to cover the fire-grate, or partially cover it, or leave it entirely uncovered, as may be desired. To effect this, the hood is to be supported on inclined rails, and counterbalanced by a weight, having over-guide pulleys, the position being regulated by a handle projecting through the front of the chimney-piece. The valve or damper to regulate the draught is to consist of a swivel-plate, provided with counterweights, and its position regulated by a handle passing through the front of the chimney-piece.

WORKING THE ROLLERS OF SHUTTERS, BLINDS, ETC.—The cords employed for raising blinds are continually getting out of order, and any invention which may do away with their use will be hailed as a boon. Mr. James Pansley of Bedford, has patented an invention which seems well calculated to effect this object. At the end of the blind-roller he fixes a wheel, whose axis is in a line with that of the roller, but it is bevelled and cogged on the side farthest from the roller. The cogs work in a cog-wheel, whose axis is at right angles to that of the blind-roller, and through it passes a metal rod which works in a socket somewhere near the window-sill. On the lower part of this rod a screw is formed, and working on this screw is a nut which traverses up and down it. When this nut is drawn up and down the screw, it gives a rotatory motion to the rod, and this sets the cog-wheels in motion, and thus the blind-roller is made to revolve. A very short screw is sufficient to cause enough revolutions of the roller to roll up the blind. This invention can be applied to rolling up maps and heavy iron shutters. In the latter case, where more power is required, the traversing nut may be made to carry a rack, into which a pinion, worked by a crank, can be fitted; in fact any other modifications may be adopted to utilize the application of the screw spindle, or rod and traversing nut.

PRINTING TRADE-MARKS ON METALLIC CAPSULES.—Mr. William Betts, City Road, has patented a simple and ingenious method of printing designs on metallic capsules. It consists in printing from ordinary type or engraved blocks; only, for his purpose, the blocks and type are carved and set up in the reverse way from what is required for ordinary printing. The reason of this will be well understood when the full operation is explained. These blocks or type forms are secured in a chase, and to them boiled oil is applied by an elastic roller, and on them is brought down a sheet of vulcanized india-rubber, just as paper is brought down by pressure on the type in an ordinary printing press. The impression

is in this way received from the type or block on to the india-rubber, and a second printing is made with gold-size on the first. The impression on the india-rubber surface is, of course, the reverse of the block; this has to be transferred to the metallic capsule, and this is effected in the following manner:—The capsule is fitted into a conical spindle of hard wood, just as a thimble is fitted on to the end of the finger, and this spindle is made to revolve on an axle, so that the metallic capsule can be made to roll along when applied to a flat surface. Checks are fixed so that it can only move over a limited surface, in order to prevent the capsule going beyond the impression which it is to receive. Colours can be dusted on to the gold-size, to which they readily adhere, or colour can be mixed with that vehicle before operating on the vulcanized india-rubber. Gold-leaf or Dutch-metal can also be applied to the pattern in gold-size. The advantages of this invention are, that it can be worked by persons who have no knowledge of painting or practice in handling a brush, and in this way cheapness combined with great accuracy are attained.

LITERARY NOTICES.

Tossed on the Waves: A Story of Young Life. By Edwin Hodder, author of "The Junior Clerk," "Memories of New Zealand Life," etc., etc. (Hodder and Stoughton.)

The Young Man Setting Out in Life. By William Guest, F.G.S. Second edition, revised. (Hodder and Stoughton.)

Both these books are out of our sphere. They are nicely got up, and will please many families in search of works intended to convey good advice.

The Elements of Plane Geometry; for the Use of Schools and Colleges. By Richard P. Wright, formerly Teacher of Geometrical Drawing in Queenswood College, Hampshire. With a Preface by T. Archer Hirst, F.R.S.. etc., Professor of Mathematics in University College, London. (Longmans.)—For some time no good teachers have been satisfied with "Euclid's Elements" as a class-book for schools, but so far as we are aware, no other work has hitherto been accepted as a substitute for it in this country, although the late Professor Davis, of Woolwich, and other eminent men, adopted a different method. A fundamental difference between the work now offered to the public and Euclid, consists in the freedom with which the former avails itself of what the editor calls "simple and incontestably true notions already in the pupil's possession," and in the extension of the use made by Euclid of the principle that identity or difference in the size of similar figures may be ascertained by their superposition. The work is divided into four books,

one on right lines, angles, triangles and parallelograms, one on the properties of the circle, another on metrical properties, and one on the equivalence of figures and the valuation of areas. We strongly recommend this work to the attention of teachers, and to students working by themselves. It is certainly much more likely to interest a pupil than Euclid. Difficulties are smoothed over in a legitimate way, and pupils of any intelligence will readily see the practical value of many of the propositions and problems. We have no sympathy whatever with those who would keep geometry difficult for the sake of mental discipline. It cannot be made too clear. Prosing over puzzles is not a good mental exercise, but thoughtfully and thoroughly learning elementary geometry possesses that character in proportion to the clearness with which the ideas are apprehended. In points of detail improvements might, no doubt, be suggested, but when we reflect on the importance of geometry, and on the plague it is usually made to scholars, we welcome a meritorious effort to place it in a new and more luminous aspect before the rising generation. If the actual results of employing Euclid as a text-book were ascertained, we should find that only those boys who had a decided talent for geometry ever apprehended its ideas. The majority grind through it as a bore, and forget one book before they have dipped into the next.

ESSAYS ON PHYSIOLOGICAL SUBJECTS. By Gilbert W. Child, M.D., F.L.S., F.C.S., of Exeter College, Oxford. (Longmans.)—This volume consists chiefly of reprints, the most valuable of which, enriched by additional matter, relate to Dr. Child's important experiments on what is called Spontaneous Generation, and to which special reference is made in an article on the Origin of Minute Life, in this Number. We should deem the other articles scarcely worth reprinting. That on Darwin's Fertilization of Orchids is valuable only from reciting facts in the original work. The argumentation that Darwin has not established the dictum, that "Nature abhors self-fertilization," is useless, as the remarks of our great naturalist are limited by the word "perpetual," which Dr. Child first cites, and then seems to ignore. The article on Marriages of Consanguinity, from the "Westminster Review," is too slight, though we should agree with what we suppose to be Dr. Child's conclusions, if they were stated with more limitation. We do not believe that any large number of consanguineous marriages do take place, or could take place, without producing in the human family results inferior to those arising from marriages of an opposite description, though we think there is little doubt that healthy progeny could be obtained from consanguineous unions to almost any extent, if the parties were selected as breeders select their stock. Human society requires a much more varied development than is needful to fit flocks of horses and sheep for economical use, and human marriages do not admit of regulation, as if the parties were merely farm cattle. The more complete the civilization of a given community, the greater the probability of consanguineous marriages doing mischief,

because the greater will be the number of reasons to interfere with the natural tendencies which induce men and women to seek diversity in their alliances.

BIBLE ANIMALS; being an Account of the various Birds, Beasts, Fishes, and other Animals, mentioned in the Holy Scriptures. By the Rev. J. G. Wood, M.A., F.L.S., Author of "Homes without Hands," etc. Copiously illustrated with New and Original Designs, made under the Author's superintendence, by F. W. Kehl, J. G. Wood, and E. A. Smith, and engraved on wood by George Pearson. (Longmans.)—This work maintains its popularity. Mr. Wood has now got amongst the birds of Holy Writ, and discourses of them in his usual interesting way. The anecdotal style, the abundance of pleasing illustrations, and the general disposition of the public to encourage all kinds of Biblical studies, will secure a very extensive recognition of the author's labours, and we have no doubt "Bible Animals" will figure prominently amongst Christmas and New Year's Gifts.

THE FLORAL WORLD AND GARDEN GUIDE. Edited by Shirley Hibberd, Esq., F.R.H.S. No. XI.—The November number of this serial is fully up to the mark. It begins with calling attention to "Garden Thorns," and gives a handsome coloured plate of a double-flowering one. "Notes on Old Flowers;" "Vegetable Forcing;" "Exotic Ferns for the Green-house;" "Forcing Asparagus;" "Plants for Small Town Conservatories;" are the subjects of other good practical papers.

GEMS OF NATURE AND OF ART. Embellished with Twenty-four Illustrations from eminent Artists. Printed in Colours. (Groombridge and Sons.)—"Gems of Nature and Art" may safely be pronounced the most splendid gift-book of the season, containing four and twenty coloured plates of rare and remarkable merit, accompanied by appropriate letter-press explanations. The frontispiece represents five of the most exquisite humming birds, superbly coloured, and grouped with flowers, so as to make a picture of great beauty. The title-page is adorned with a circular landscape, representing the haunt of a kingfisher. "Beautiful Shells" and "Butterflies" afford good subjects for two other plates; and we notice a superb new "Passion Flower," and a new "Rose," gracefully depicted in two others. Several of the plates will be recognized by our readers as having made their first appearance in the "Intellectual Observer," but larger margins, and very careful printing, give them a new aspect. The fine "Cameo of Augustus;" "Examples of Mediæval Art;" "Ancient Jewelry;" and Mr. Fairholt's gorgeous and truthful "Sunset on the Nile," belong to this series, and well deserved republication. The binding of this volume is rich in colour, and artistic in design. The publishers must have great confidence in the improved taste of the public to justify the issue of such a work at an exceedingly moderate price, but we have no doubt its great superiority to ordinary drawing-room books will ensure for it a large sale.

NOTES AND MEMORANDA.

Chemical Actions of Light.—Professor Tyndall describes, in the Proceedings of the Royal Society, some new and very remarkable experiments, made by exposing the vapours of volatile liquids, contained in a glass tube, to the action of concentrated beams of solar or electric light. Nitrite of amyl became cloudy, and let fall a shower of liquid spherules. The chemically active rays of the light appears to be stopped by the substance from which the vapour is obtained, "the liquid and its vapour absorb the same rays." Sky-blue was obtained when nitrite of amyl was employed, and hydriodic acid afforded most curious spherules of delicate clouds, like changing flowers and fish, some of which are described as of great beauty. A remarkable fact in this experiment was the "*twoness* of the animal form." No coil, disk, or speck created on one side of the axis of the tube that had not its counterpart at an equal distance from the other.

The Spectrum of Lightning.—Lieut. John Herschel has communicated to the Royal Society an account of the spectrum produced by lightning. He says, "The principal features are a more or less bright continuous spectrum, crossed by numerous bright lines, so numerous as to perplex one as to their identity."

Sugar from India Rubber.—M. Aimé Girard describes, in "Comptes Rendus," a kind of sugar obtained from the caoutchouc of Gaboon, which the natives call *n'dambo*. This caoutchouc is not produced by the india-rubber trees, but by a species of lianas, and cannot be worked in the usual way. Decomposing it by heat, M. M. Girard, and Aubert, of Greville, found amongst the volatile products a white substance, crystallized in fine needles, and having a sweet taste. M. Girard states that the juice of the Gaboon lianas, freshly imported, evaporated at a gentle heat, dries into a coloured crystalline mass, which, when acted upon by alcohol, yields the caoutchouc sugar, which he calls *dambonite*. It melts at 190, and volatilizes at 200 to 210°. It is composed of $C^8 H^8 O^6$.

Subterranean Trout.—*Cosmos* states that an Englishman went fishing in a river that runs at a great depth in the grottoes of Rochefort, and caught a fine trout, 200 metres below the surface of the soil.

Velocipede Travelling.—*Cosmos* states that nine young men left Rouen one morning, at 7 A.M., on velocipedes, and by 9 P.M. reached Paris, a distance of 32 leagues.

Sea Depths.—Soundings for submarine cables show that the Baltic, between Sweden and Germany, is 40 metres deep; the Adriatic, between Venice and Trieste, 42; the English channel, 100; the Irish Sea, in the S.W.,660 ; the Mediterranean, east of Gibraltar, 1000; coasts of Spain, 2000; by Cape of Good Hope, 5000 metres.

Breeding Ostriches in Algeria.—M. C. Rivière, Director of the Gardens of Hamma, near Algiers, reports success in rearing ostriches in a park, supplied with a palisade enclosure, containing a quantity of fine sand. Before depositing her eggs, the female ostrich seems uneasy, and seeks a suitable place. She forms a small hillock of sand, slightly concave at the top, and lays one egg in it, to which she afterwards adds others. She lays every two days, for two or three months, with an interval of repose. Incubation lasts forty days, during which time the male and female sit alternately. On the 12th of March five were hatched, and three the day after. At the end of May some ostriches had laid their fiftieth egg. The males take great interest in the incubation, and only leave the eggs when pressed by hunger, and then the females take their place, but not for such long periods. An extra circulation goes on in the uncovered portions of the male's body, to generate the heat necessary for the process. The same fact is noticed with cassowaries.

CARCLAZE; AN OLD CORNISH MINE.

BY PROFESSOR CHURCH, M.A., F.C.S.

(*With a Coloured Plate.*)

CARCLAZE has a character of its own. It is no ordinary Cornish mine with the gaunt structure of a pumping engine, and long and ugly lines of sheds, above ground, with dark, hot and low galleries beneath. When you approach Carclaze you see none of the usual signs of mining operations, none even of the indications of past labour in those heaps of refuse which surround most workings, and which do not improve the aspect of a by no means fertile county. Utterly barren these heaps usually are; and they make most desolate those mines (and of such there are, alas, too many), which are now silent and abandoned.

Carclaze is best reached from Saint Austell, a town about 240 miles from London, and a station on the Cornwall railway. Two lanes lead from the town to the mine: it is better to take that one which opens into the Market Place, close by the west end of St. Austell Church. It is a hilly, deep, and winding lane, but at last brings you out upon the moor, bright, and usually breezy too, in summer, but very drear in winter. White roads intersect this moor, and along them pass continually towards the sea, three miles distant, waggons and carts laden with square blocks of a substance of dazzling whiteness. Each cart has at its back a shield-shaped spade, placed point upwards amongst the blocks.

Once on the moor, you are, without knowing it, close to the mine. Before you, a little to the right, are a few cottages, while an undulating line of heather and turf bounds your view a few hundred yards beyond. This line is artificial, and has been made during the long lapse of years by the refuse of the mine. But this refuse is not barren like that of copper mines; it soon becomes covered with the usual moorland herbage. Pass a few old cuttings and roadways,—here and there a channel with a singularly-white mud in it, and then a few steps bring you to the grassy edge of a great pit or crater. This is Carclaze tin mine. Not that tin is now its chief product, but this was the case, till, towards the close of the eighteenth century, the very earth, or soft rock, of which the whole place seems to consist, was found to be the kaolin of the Chinese—the China-clay, which is so precious an ingredient in the manufacture of porcelain and the finer sorts of earthenware.

Carclaze, then, is a great hollow, some 150 feet or more in depth,

more than a mile in circumference, full of ramparts and pinnacles of soft clay of almost alpine whiteness. Looking down from the edge of the moor, you see here and there wheels at work, raising and letting fall in succession the wooden stampers which crush the crude tin ore. You see the *leats* and *maunders* which conduct the water to the stamping mills, and to the *buddles* where the ground ore is washed and purified; you see, also, signs of the more important operations with the kaolin itself. At the top of the pit the peat and the peat-stained upper layers of clay are being cut out and carted away; lower down, may be seen men and boys at work with pick and spade, throwing down the clay into the streams below, that there its pure white and fine particles may be carried off suspended in the water. The milky stream finds its way through an underground adit or tunnel, which opens on the slope of the moor several hundred yards below the mine, and nearer the sea. We shall return to its examination presently; meanwhile we complete our study of the mine. The refuse of the clay washing has to be got rid of: this occurs in the lower regions of the mine, and as it would be too costly to raise this to the upper level of the moor, it is conveyed through a second tunnel, and discharged at points where it will least incommode the subsequent operations. The walls and ramparts and pinnacles of soft *growan* dazzle the beholder by the glare of their whiteness—a glare which is almost intolerable in sunshine; but these walls are not wholly white. Pretty uniformly distributed through the soft rock are dark grey, and even black veins. These veins are not horizontal, but variously inclined. They occur in two or three systems of parallel lines, and intersect one another, one of the most prevalent of these systems having a considerable dip to the south-west, and another being nearly vertical. These veins consist in great part of a dark or black variety of tourmaline called schorl; but accompanying this mineral are several other mineral species and notably tin-stone or cassiterite. This valuable ore is here present in but small proportion in the veins of schorl; in fact, it occurs so sparingly, as barely to pay for the cost of working it. It is separated from the accompanying rock and minerals by the process locally termed *buddling*. The buddle, in its simplest form, is a shallow flat-bottomed trough, some seven feet long and three feet wide, set at a slight incline. The ground ore is placed at the summit of this incline, while water from a conduit or maunder is made to flow in an uniform manner over the ledge at the top of the buddle, and then on to the ore. The miner in charge has a shovel and a broom at hand. With the former he

adjusts and arranges the ore, making slight channels in its surface for the passage and distribution of the water; with the latter he continually sweeps back the particles carried down the incline of the buddle, in order to submit them again and again to the separating action of the water.

The light rocky and mineral particles are thus washed away, while the heavy tin-stone remains behind; the specific gravity of this metallic oxide, called black tin, being between 6 and 7, while that of the accompanying minerals is much less. The density of the schorl is about 3, that of the quartz 2·65, and that of the felspar and mica very nearly the same. We have not space to follow the cleansed ore in its subsequent treatments, till it appears in ingots of shining metal—white tin, as it is called—on the quay side, at Charlestown, the little port of St. Austell Bay. Yet we ought here to mention that ingots of tin, and the remains of the rude furnaces in which the ore was smelted in early times, have been repeatedly discovered in the tin districts of Cornwall. The ancient trade in tin must indeed have been very large. This metal was used chiefly for the making of bronze, which contained 13 per cent., or thereabouts, of tin—of mirror, or speculum metal, which contained 40 per cent.—and of other alloys: preparations, of which tin was an ingredient, were also employed by the Romans for various other purposes connected with industry or the arts. It is needless to particularize the uses to which the metal tin, and its compounds, are now put. Enamellers, glass-stainers, metal-workers, dyers, all use it. The quantity raised in Great Britain in the year 1863 amounted to 10,000 tons, valued at £1,171,000 sterling. This amount was the produce of 170 mines in Devon and Cornwall.

Before I leave Carclaze mine, I must say a word or two about its miners. On most occasions, when I have visited the place, I do not suppose there were a dozen men and boys at work in the pit. In fact, the mine is worked in a very primitive and not very effective way. Some of the mines near, where the same China-clay is dug, have steam-engines, and every sign of systematic and economic working; but old Carclaze, with its ancient associations and quaint old mills, and tramways, and tunnels, and conduits, is a little behind the age. They might store up during winter, in reservoirs cut in the moor above, abundance of water for summer work, but this notion seems to have been scarcely even thought of. It is said that there is over-production of clay now, for many new workings have been commenced in the neighbourhood, one only a quarter of a mile distant from Carclaze. But we are forgetting the workmen. A few

of these are men, most of them lads of 16 to 18, and some much younger. They are civil, obliging, and ready to show to the few strangers who visit the place, the old pit, in which they take an evident pride. The younger boys get 10*d.* a day, or thereabouts; the older ones as much as 15*d.* to 18*d.*; and the men 2*s.* In fine summer weather the work is by no means unpleasant, but in winter the case is different indeed. These miners, however, are a hardy race—independent in character, and live in happy ignorance of our big cities. A village is a "town" in Cornwall, and the Carclaze miners have their town in St. Austell, which, however, has 10,000 inhabitants. The Carclaze miners were astonished at the apparatus of an artist, and at his perseverance in working at one picture for three weeks. An admiring and communicative circle gathered around him every day at the dinner hour, and, as each conduit, mill, or other feature of the place was introduced and figured, its name and history were duly discussed. Local names of minerals and mining apparatus are numerous and instructive; men, also, came in for their share of nicknames. I was struck by the strange appellation of the miners at Carclaze; one, for example, was called "Perry Wince"—as far as I could make out, this was the name of his native village. Another was known as the "Preacher"—his tendency to sermonize seemed, however, not unmixed with a tendency to swear.

Before we leave the moor, to follow the white clay-laden stream on its passage towards the sea, we may spend a few minutes in examining a granite tor, called Carnegrey—a short distance north-east of Carclaze. It is a mass of exposed granite, greatly weathered, and, consequently, in part separated into distinct masses. No sign of work appears here. We mount the tor, and, looking northwards, see scattered about engine-houses, and church towers, and clumps of dwarfed trees; and in the distance the wastes of Bodmin Moor, and above them the bare and stony heights of the chief Cornish mountain, Brown Willy.

We turn our eyes downwards, and to our astonishment discover that the great granite tor on which we stand is being quarried away. Concealed from sight, till we had mounted the granite tor, are the hoists and plant of a quarry, with great blocks of granite dislodged by blasting, and many rows of dressed stones. This granite is not a mere common grey granite; it here and there shows two other minerals, besides its usual constituents. One of these extraneous minerals is fluor spar of a rich and deep violet colour. This fluor is occasionally found so regularly disposed throughout the rock here that it gives

the granite a very rich and unusual aspect. The other curious mineral at Carnegrey is *chloropal,* a hydrated silicate of iron and aluminium, which coats some of the fissures of the granite masses with a soft yellow-green, and wax-like film. This mineral was first discovered in England in this quarry in 1866, but it occurs in other granite quarries of the district. A very curious porphyroidal granite occurs at Luxulian, a few miles from Carnegrey. It is very striking in appearance, consisting mainly of black tourmaline, and big flesh-red crystals of felspar. From a block of this beautiful rock, the sarcophagus of the late Duke of Wellington has been wrought.

Let us now study the preparation of China-clay or kaolin. The stream in which the clay is suspended emerges from Carclaze on the slope of the hill, which is here levelled into terraces. When the water has left all its impurities, and coarser particles of clay, it runs into tanks or pits upon the terraces. Left to repose, the clay is here deposited, and the water above it, when nearly clear, and showing a beautiful greenish-blue colour, is drawn off. This process is repeated till a sufficient thickness of deposit has been obtained; then the clay is allowed to dry partially, and finally cut out into blocks, stacked and completely dried, either naturally or by artificial process. It is then carted away, and sent, usually in barrels, either by rail to Staffordshire and other pottery districts, or by ship to various Continental ports.

This clay is identical with the kaolin of the Chinese. Both in Cornwall and the other countries where China-clay occurs, it is accompanied by a harder rock, called China-stone. This stone is quarried in the usual way, and is found abundantly in the St. Austell district, though not at Carclaze. It is probably the *petuntze* of the Chinese. China-stone differs from China-clay by its greater hardness, and by the larger proportion of quartz and undecomposed felspar in it. In the native clay, as well as in the stone, several minerals—some of them products of change—may be found. A yellow-green talcose mineral is the most important of these. While the pure clay itself is a definite mineral species, resulting from the complete alteration of common orthoclase felspar, believed to have been present in the original granite rock, the other ingredients of the rock have either remained unaltered or given rise to a variety of products. The quartz is unchanged, and there accompanies it at Carclaze a mineral which may be white mica. The place of the hornblende in some of these granite rocks is occupied by tourmaline, and this remains unaltered. Sometimes crystalline masses are enclosed in the china-stone, and have the appearance and composition

of yellow mica, and yet the figures of the masses are those of a triclinic felspar. Occasionally, too, crystals of undecomposed or partially decomposed felspars of different species occur in the native rock. But, after all, the kaolin of commerce is usually a perfectly definite compound, and, owing to the recent researches of Johnson and Blake, now takes rank as a distinct mineral species under the name of *kaolinite.*

Kaolinite is a pure silicate of alumina and water. In two parts it has the following composition :—

Silica (SiO_2)	- -	46·3
Alumina (Al_2O_3)	- -	39·8
Water (H_2O)	- - -	13·9
		100·0

Translated into a chemical formula these proportions become :— Al_2O_3, $2SiO_2$, $2H_2O$. It is commonly said that clay is alumina, but pure clay is here seen really to contain more silica than alumina. Kaolinite is soft; its specific gravity is about 2·6. Under the microscope it is seen to consist of pearly hexagonal plates of the prismatic or trimetric system. Though kaolinite in the mass looks earthy, the individual plates of which it consists are translucent and have a pearly aspect, which is well seen when the substance is stirred up in water. Figures 1 and 2 represent respectively a single highly-magnified plate of kaolinite, and a number of plates aggregated together.

The use of the kaolin of Cornwall, for the manufacture of china, dates from about the middle of last century, and was due to a member of the Society of Friends, William Cookworthy by name, a native of Kingsbridge, in South Devon. A letter of Cookworthy, dated May 30th, 1745, mentions a person from Virginia, as having informed him of the discovery in Virginia of kaolin and petuntze, the materials used in China in the manufacture of porcelain, and specimens of which had been brought to Europe in 1712. It has been stated that Cookworthy first discovered procelain granite in the tower of St. Columb Church, which was built of that stone from St. Stephen's, the district whence Cookworthy first brought his kaolin. From a letter (Nov. 30th, 1790) of Lord Camelford, who was the partner of Cookworthy in the Plymouth Porcelain Works, which were established about 1768, it seems that the actual detection of kaolin and petuntze at St. Stephen's was due to a friend of Cookworthy's. This early use of Cornish china-clay in a porcelain manufactory was

not extensive, and the Plymouth Works were soon transferred to Bristol, the patent interests being purchased by a Mr. Champion of that city. Specimens of Cookworthy's Plymouth porcelain are very scarce; they are often marked with the symbol for Jupiter, ♃, a sign also of the metal tin, and therefore a very appropriate mark for a ware made from materials which had been obtained from a district rich in tin mines. This Plymouth ware as well as that subsequently made at Bristol, was *hard* porcelain, unlike the old *pâte tendre* of Sèvres, and the modern English manufactures, but resembling in this particular the Oriental porcelain, which it was intended to imitate.

ON THE SACK TREE OF THE EAST INDIES, AND OTHER FIBROUS BARKS.

BY JOHN R. JACKSON,

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In the August number of the Intellectual Observer, we gave a brief description of the bark of the Pottery Tree of Para, and promised in an early issue to refer to other peculiarities of bark structure.

Those which we now propose to treat of belong to an entirely different kind to the silicated or stone-like barks, and are some of the most peculiar of the fibrous series. Simply fibrous barks occur in many distinct natural families, but the most peculiar and beautifully-formed of this description are to be met with, perhaps, in three or four orders having no affinities to each other, and the plants of which grow in widely different parts of the world. Thus, for instance, there is the Lace-bark of the West Indies, the Tapa of the South Sea Islands, the Sack Tree of the East Indies, and the Currie-jong of Australia. Many of our readers, and especially those who have been in one or other of these parts of the world, have probably been struck with the beauties of some of these barks, when converted by the natives into various useful or ornamental purposes for which they are used. We need not recapitulate the natural formation or structure of barks in general, the remarks we made at the commencement of the notice of the Pottery Tree* will be fresh in the minds of our readers, and will serve as a guide to what we may say hereafter. The Sack Tree, to say the least of it,

* See "Intellectual Observer," vol. xii., p. 49.

is a singular name for a plant to possess, but it is one which we shall show is peculiarly adapted to the tree that bears it, inasmuch as these natural sacks are in common use amongst the natives. The tree producing this apparent anomaly is known to botanists as *Antiaris saccidora*, Dalz., and is a native of Western India, where it grows to a very large size, frequently attaining 100 feet in height, with a diameter of six feet. The bark is thick, strong, tough, and fibrous, and is used by the natives for making cordage, as well as for sack-making. These sacks are procured in the following ingenious though certainly simple manner.

The younger or smaller trees are selected according to the size of the sack required. A trunk about a foot in diameter is perhaps the most useful size. A block or junck is then cut out the length of the proposed sack. These entire blocks are placed in water to allow the bark to soak and soften, after which it is beaten all round with clubs. By this means the outer bark is entirely removed, and the inner bark made soft and pliable, and loosened from the wood. It is then turned back over the wood, or actually turned inside out; and to complete the sack, it requires nothing but sewing up at one end, and even this in some cases is entirely dispensed with, and the sacks have not a stitch in them. In this case the wood is sawn off within a few inches of the end, from which the bark is not stripped, so that it forms a natural wooden bottom to the sack. One would think that these natural sacks would be more for curiosity than for use; but in Western India and Ceylon they are much used by the natives for carrying various commodities, as rice, etc., and are sold for six annas each. Of course they have not the finished appearance of a woven or manufactured sack, but still they answer the purposes to which the natives put them, and in lieu both of better materials and manufacturing ability, the manufacture exhibits an amount of ingenuity and adaptation for which the natives of many parts of the semi and uncivilized world are noted. There are some specimens of these peculiar sacks in the Museum at Kew, one of which measures six feet in height, and one foot in diameter. Besides this application of the bark, the natives also use it for making articles of clothing. For this purpose, it is stripped off the wood in pieces, and allowed to thoroughly soak in water, when it is beaten out till it becomes quite white and rough like fur. These pieces are then cut into the shapes of the different garments required, and the pieces sewn together. Furthermore, the bark makes excellent paper. The fruit of the tree is about the size of a small fig, and from this fruit a quantity of gummy

juice exudes. The seeds are very bitter, but neither the fruit, seeds, or gum are applied to any economic use.

Nearly allied to this tree is the celebrated Upas of Java (*Antiaris toxicaria*, Lesch.), about which we have been told such fabulous stories. The "tapa," or Paper Mulberry, of the South Sea Islands, is a near relation also, so that these three plants are instances of a connection by natural affinities, though widely separated in their geographical position.

The Paper Mulberry (*Broussonetia papyrifera*, Vent.), is a branching deciduous tree, about twenty or thirty feet high, and averaging one foot in diameter. The leaves, which vary considerably in shape according to their age, are covered with hairs, the upper side being indeed very rough, and the lower much less so. The plants are monœcious—the male and female flowers upon separate trees, the former being in pendulous catkins, and the latter in globular masses, like small compact balls, not larger than marbles. The fruits which form from these female flowers are red, fleshy, and similar in appearance to a mulberry, to which natural order, indeed, the plant belongs. It is indigenous to most of the islands of the Pacific, as well as to China and Japan. It is in the Pacific Islands that the natives manufacture from this bark a peculiar kind of cloth which they call "tapa," or "kapa." It is very strong and tough, and is most extensively used for articles of clothing. The trees are cultivated in many parts entirely for the sake of their bark, and are planted in regular groves. Each is kept trimmed to a single shoot from its earliest growth, so that the stem may grow up without much branching, and when it has attained an inch or two in thickness, and from ten to twelve feet high, it is considered ready for use, and is cut down. The bark is taken off in a single piece, a longitudinal incision being made from end to end. The outer bark is then scraped off, and the inner spread out and rolled flat. It is now placed in water, and left till it becomes covered with a kind of mucilage, when it is taken from the water and laid on a plank of hard wood, and beaten with a kind of short club, likewise of hard, heavy wood (*casuarina*), having four flat sides, one of which is quite smooth, another coarsely grooved, the third very finely furrowed in the same direction, and the fourth more or less checked in squares or diamonds. The length and breadth of the piece of cloth in process of manufacture is increased at pleasure by fresh additions of the bark, and should any part have become thinner than that surrounding it, a piece of fresh bark is placed over it, and beaten out to the required thickness.

After the whole piece is beaten, and is of a sufficiently even texture, it is exposed to the sun to dry or bleach. The grooving of the sides of the hard wooden mallet or club has the effect of giving a kind of pattern to the so-called cloth; that beaten with the coarse grooved side has an appearance somewhat similar to dimity; that with the finer, more resembling corded muslin; and that with the check pattern more like fine diaper. When the flat side is used, a perfectly smooth surface is obtained.

This tapa cloth is made of various degrees of thickness, some sorts being so exceedingly thin as to resemble muslin or crape, while others are very thick and tough, almost like leather. It is used for a variety of purposes. All kinds of clothing, both for men and women, are made from it, as well as coverings for sleeping, or counterpanes, many of which are as large as a full-size English counterpane. In many parts, the mucilage from the arrowroot is used to unite many pieces into one large sheet, all of which are beaten out by the wooden mallets into one uniform thickness. In the Museum at Kew, is part of a piece which Sir Everard Home mentions as being made for Josiah Tubo, King of Tongataboo. It measured two miles in length and twenty feet in width.

The tapa cloth, after being prepared as we have described, is naturally of a light colour, and when bleached, it is nearly white, but the greater part of that in common use amongst the natives is dyed or printed in various colours or patterns, and the preparation of dyes for this use show an amount of skill and intelligence which is apparent in many other works of these tribes. Most of the colours are obtained from indigenous plants, and the colours themselves are often very bright.

The printing of patterns is done by a kind of type. If a small pattern is needed the type or figures are cut on the inside of a strip of bamboo, a long piece being left for a handle. This bamboo pattern is then dipped in the prepared colour and transferred quickly but carefully to the tapa, the pattern being pressed upon the cloth by running the fingers along it; the operation is repeated till the whole piece of cloth is covered with the pattern. To make the cloth more durable and waterproof it is frequently steeped with cocoa-nut oil, which, moreover, is sometimes perfumed with chips of sandal-wood or seeds of an odoriferous pandanus.

In the Kew Museum there is a very complete collection of these cloths, of the oiled or waterproof kinds, plain and dyed, and of the numerous figured sorts, also cloths in the various stages of manufacture, as well as the instruments used in their preparation. In

China and Japan the plant is grown to some extent, chiefly for paper-making, for which purpose the young shoots alone are used. They are cut into pieces and boiled until the bark has become tolerably soft, and separates easily from the wood, when it is taken off, dried, and stowed away for use at any future time.

The process of the manufacture of paper is very simple. The dried bark is placed in water until sufficiently soaked, it is then scraped with a knife to rid it of all impurities, after which it is boiled in a ley of wood-ash, which effectually separates the fibres so that it is readily reduced to a pulp by continued beatings. This pulp, or "half-stuff," as it would be called in the trade, is next mixed with a sufficient quantity of mucilage and laid out upon frames to dry. The paper thus made is remarkably fine in texture and very stong.

The Lace-bark Tree of Jamaica (*Lagetta lintearia*, Lam.) is another example of a remarkable fibrous bark, the applications of which are as numerous and varied as those we have just described, and the structure is infinitely more beautiful. It is composed of numerous concentric layers of very fine and strong fibres, which form a complete reticulation interlacing in all directions, so that when the bark is beaten out and the fibres separated, by carefully pulling them in a lateral direction, it has much the appearance of white lace or net. If the outer bark be removed from a tolerably sized stem these inner cortical layers can be separated most easily, and by care can be pulled out to a width of a yard or more, while any length may be obtained simply by cutting the stem to the length required. The bark, as seen on the wood, is apparently close and compact, and is seldom or never more than about a quarter of an inch thick; but though the outer surface of the bark as it covers the trunk does not give any indication of its fibrous nature beneath, a cross section of the wood at once discloses its soft or stringy formation. This natural lace is used by the natives for a variety of economic purposes, such for instance as the manufacture of hats, caps, collars, etc. In the Kew Museum there is a large collection of these native manufactures, together with specimens of the stem and bark in a natural state.

A writer, speaking of the Lace-bark, says:—"The ladies of the island (Jamaica) are extremely dexterous in making caps, ruffles, and complete suits of lace with it; in order to bleach it, after being drawn out as much as it will bear, they expose it, stretched to the sunshine, and sprinkle it frequently with water. It bears washing extremely well with common soap, or the *coratoe* soap, and acquires a degree of whiteness equal to the best artificial

lace. There is no doubt but very fine cloths might be made with it, and perhaps paper. The negroes have made apparel with it of a very durable nature. The common use to which it is at present applied is rope making. The Spaniards are said to work it into cables, and the Indians employ it in a variety of different fabrics. It may, perhaps, be of service to Great Britain as a manufacturing nation, but the inhabitants of these colonies are very seldom disposed to improve what nature offers, or apply many productions here to the obvious uses for which they are intended. Necessity, that great spur to such improvement, is wanting to stimulate, or otherwise they would soon find out methods of turning them to account."

Strong and durable horsewhips are made of this bark by the natives; for this purpose a twig or stick, about the thickness of a walking-stick or ordinary whip-handle, is selected, it is cut to the required length, a portion of the bark is then loosened from the wood, beaten out into fibre, and stripped down to within a certain distance of the thick end, where a piece is left untouched for the handle; the loose fibre is then tightly plaited, and forms an excellent thong. In former times the whips used to flog the slaves were nearly always made in this fashion and of this material. Charles II. is said to have had presented to him by the Governor of Jamaica a shirt-frill, a pair of ruffles, and a cravat, all made of Lace-bark. And when well and carefully made such articles are hardly to be distinguished, except by examination, from real lace or net, and more especially when made into such things as bonnets, where coloured ribbons can be used to set off the whiteness of the bark. The generic name of the Lace-bark Tree is derived from the native name of Lagetto, by which it is known in Jamaica. It is a tree growing some twenty-five to thirty feet high, and belongs to the natural order *Thymelaceæ*, of which the common mezereon is a British representative. The flowers have a tubular perianth and a distended tube containing eight stamens; the fruits are small, round, and hairy. The plant is frequently cultivated in hot-houses in this country, more as an object of curiosity than for its beauty.

We hope this brief description of these beautiful textile barks, if we may be allowed the term, may be found sufficient to arouse an interest in them amongst our readers, and may lead to the actual examination of the barks themselves, as well as of others of minor beauty not mentioned here.

A VISIT TO MATHERAN.

BY J. G. HALLIDAY, LIEUT.,-COL.

(*Continued from p.* 368.)

BOTANY.—Though the season of our visit to Matheran was certainly not the most favourable for the observation of many, especially of the herbaceous plants and flowers, yet I found unfailing interest in the study of the numerous trees and shrubs, some of which I will now enumerate, not with any very close adherence to systematic classification, but rather as they presented themselves to me in my rambles. The flora strikes the eye at once as characteristic. About the lower slopes grow a few trees of *Tectonia grandis;* but this tree, of so noble growth in some of our Indian forests, is here of very moderate scantling, and, moreover, being entirely stripped of foliage, did not show to advantage. Higher up the sides of the hill, and in some of the ravines, *Sterculia urens,* some of very considerable size, strikes the eye; strange and gaunt: the white outer bark peels off from year to year, giving the tree a curious dead appearance when stripped of all its leaves, as was the case during the earlier part of our stay; but latterly, the beautiful large five-lobed velvety leaves were clothing the higher branches, adding greatly to its appearance. The little fascicles of stinging hairs from the outside of the seed-vessels form rather a curious microscopic object.

Salmalia Malabarica, with its curious prickly trunk, also occurs, but the flower had passed before our visit. *Syzygium jambolanum* is a common tree on the plateau, and among the largest growing there. The blossoms were passing off, and the berries forming during the period of our visit: these berries are eaten when ripe, and are not unpleasant, though with the characteristic roughness of the Myrtaceæ. *Terminalia chebula* is pretty common, the terminal spikes of small flowers showing themselves early in May. Graham notes (in his Bombay Catalogue) that leather-workers use the fruit as an ingredient in their blacking. *Albizzia* (or *Acacia*) *stipulata* was in full blush of blossom during almost the whole of our stay, forming a conspicuous object, especially when from some vantage ground we could look down upon its flat head, almost a mass of blossom, among the other trees of the wood. Beneath it the ground is strewed with the long feathery purple stamens; and the perfume

warns at once of the vicinity of the tree. On the whole the Legumenosæ appeared to me less well represented than is generally the case in India. The small white-blossomed *Bauhenia racemosa*, with its pretty leaves, occurs sparingly; a *Crotalaria*, perhaps *C. leschenaultii*, but it was not in blossom, and I could only find a few of last year's pods; *Acacia rugata* (*Mimosa concinna*, Roxb. fl. Ind.), with its very elegant foliage, often disagreeably reminds one of its presence, its numerous strong recurved thorns impeding progress through the jungles. I found the Tamul name, *Chicakai*, in use in this part of India also; the legumes are commonly used as a detergent. *Butea frondosa*, too, was clothing itself with its handsome trifoliolate leaves; but I do not find any others of the tribe in the record of my botanical rambles. The shining silvery-backed leaves of *Elæagnus conferta* attracted my attention; they are well worth taking home for examination, forming a very pretty low-power microscopic object; and the scurf from the back, mounted in balsam, gives beautiful polariscope effects.

The Chinchonaceæ are well represented. *Randia dumetorum*, pretty and abundant, remains long in blossom, so that blossoms and fruit are on its spring branches at the same time. The flowers are almost sessile, coming out white at first, they turn yellow as the day goes on. The ring of upright hairs inside and near the base of the corolla tube is pretty in dissection. The poisonous fruit is about the size and shape of a crab apple, with a thick hard rind. The seeds are said to be used for poisoning fishes.

Pavetta Indica is a pretty little shrub, about three or four feet high, striking from being quite denuded of leaves while covered with the white fragrant, tetramerous, long-styled blossoms. Of Ranunculaceæ I found both *Clematis gauriana* and *C. Wightiana* climbing among the bushes, with a few of their feathered seeds left upon them, but they were not at all in their beauty. *Jasminium sambac* is abundant everywhere. The tall but perished stalks of *Cynoglossum furcatum* were all that remained to show that at the proper season this pretty ornament of our Indian hills thrives here also. *Guidia eriocephala* represents the Thymelaceæ; but its pretty yellow, and, as the name implies, somewhat woolly flowers were not numerous. The natives are quite aware of its poisonous qualities. Of the very numerous Acanthaceæ I was, owing to the season of the year, unsuccessful in finding or identifying many. One, *Strobilanthes glutinosa*, in Graham's Catalogue, is very abundant, many of the more open spaces of the jungles being covered with its upright stalks, which are cut by the natives for fences, and many other pur-

poses for which the bamboo, here absent, is elsewhere used. When I saw it, it was but sparingly ornamented with its very deciduous bluish-purple blossoms. The bracteoles and calycine segments are covered with stalked glands, giving it a peculiar clammy feel, and a strong aromatic smell, sometimes, especially on a still, warm evening, very perceptible, even when passing at some little distance from the plant. Is it *Endopogon integrifolium*? Climbing high, not merely over the underwood, but even over considerable trees, growing profusely in some spots, but not very generally distributed, is *Getonia floribunda,* belonging to Combretaceæ. The greenish flowers are in large axillary, or mostly terminal panicles; the opposite leaves are curiously dotted beneath. By the middle of May it was passing off.

A very elegant tree, with drooping branches and dark glabrous leaves, occurring but sparingly in the jungle, is the *Garcinia purpurea,* of Roxburgh's flora. It is closely allied to the famous Mangosteen, of Malaga, the fruit very much resembling it outwardly, in miniature, being about the size of a green gage, crowned with the remains of the peltate stigma; of a rusty purple when ripe; it is eaten by the natives, but is especially noteworthy as producing a concrete oil, or vegetable wax, called kokum by the natives. It forms an excellent application for chapped skin, and for such like purposes. A small upright tree, with foliage of a grey-green, the leaves in drooping terminal clusters, with almost a palmate appearance, occurring so commonly as to be quite a feature of the place, is *Tetranthera lancifolia,* placed in Lauraceæ. The fruit is very pretty, clusters of miniature acorns, green when we first saw them, but the glans becoming bright red as it ripened, after which it soon falls out of its cuplike receptacle. *Callicarpa* (*cana* (?) or *tomentosa*) is also a very common shrub, with small opposite axillary cymes of light purple flowers, the whole plant covered with stellate tomentum, which I have found it quite worth while to mount dry for observation: it shows to best advantage with dark field illumination. The little berries become almost black when ripe, and birds, especially the bulbuls, so abundant, as was before remarked, are greedily fond of them.

Many of the common trees on Matheran are laden with large growths of Loranthaceæ, among which I noted at least two species, *L. loniceroides* and *L. longiflorus*. These singular plants are well deserving of study, the flowers are pretty as well as curious, and the mode of germination should always be observed when opportunity offers. The ripe seed adheres firmly to any branch on which

it may happen to fall, the radicle soon appears from the opposite end of the seed, and as it elongates, gradually curves round towards the supporting branch, on reaching which it becomes enlarged and flattened, and gradually an intimate union takes place between the woody system of the stock and of the parasite. I have noticed that they ultimately destroy the trees on which they grow.

The curious slipper plant, *Pedilanthus tithymaloides*, thrives and blossoms abundantly; but from the places where it occurs it has the appearance of being an introduced plant. The glaucous, unhealthy-looking *Asclepias gigantea* grows, but only in solitary instances here and there; indeed, I am not sure that I know of more than that one spot on the plateau of the hill, where it may be looked for.

The Urticaceæ find their representatives in a good many individuals. *Ficus Indica*, the banyan, is not very common; the oblong, smooth, polished leaves of *Ficus comosa* show themselves occasionally in the woods; and *Ficus glomerata* (Rox. flora) is very abundant, and from the masses of fruit that it carries it forms a striking object. The figs which are eaten by the natives, are not bad stewed, though somewhat insipid, but with a fine fruity smell. However, they are often found filled with minute flies. A mango-tree is very common all over the hill, the fruit is small and somewhat globose, hanging from a long pedicel; it is eaten by the natives. Is it *Mangiera sylvatica* of Roxburgh?

Ziziphus rugosa has been mentioned above with reference to the pretty beetle found on it, and I think on no other plant. It is a straggling thorny shrub, with three nerved leaves; the berries in terminal panicles become yellowish-white when ripe; they are eaten by the natives, and I have often gathered and eaten them, but they have little flavour, reminding one somewhat of *haws*.

Apocynaceæ gives some of the prettiest flowers on the hill. *Carissa carandas*, a thorny shrub, with oval, coriaceous, short-petioled leaves, occurs very abundantly in the lower ravines; the berry has not at all an unpleasant taste, and is sold in large quantities in the bazaars or native markets under the name of corinda. There are many others of this order, some of which I did not accurately identify; one especially abundant and fragrant, which is, perhaps, *Tabernæmontana dichotoma* of Rox. flora?

A large climbing shrub, twining its huge limbs from tree to tree, cannot fail at once to attract the notice of the observer, both from its habit, its leaves (which have gained it the name of "Matheran ivy" among English visitors), and its curious clusters

of fruit, like bunches of very glaucous grapes clinging abundantly to the rough stems; the leaves are orbicular cordate, about three inches across, and the whole plant has a remarkably pretty effect. It is *Cocculus macrocarpus.*

Leea staphylea is a plant so abundant as to form quite one of the features of the place, and on examining it one certainly cannot but feel that those botanists who have doubted the propriety of classing it among Vitaceæ have had much reason for their doubts, though I believe the genus retains its place in the order. The compound leaves are very elegant, and the young shoots are of a very beautiful crimson. Minute as the flower is, it is well worthy of dissection and examination; the urceolate stamen tube is very pretty. Another very elegant member of this elegant order is *Cissus discolor,* a glabrous climbing shrub, with distant digitate leaves, purple and shining beneath; the young shoots being also red; the four petals of the minute flower cohere into a tube. This flower also is well worth the most careful examination.

In the Aurantiaceæ we find *Bergera Koenigii* (or perhaps *B. integerrima*) growing very abundantly; it is locally known as *Jungli neem.* I know not why, for it has no one feature in common with the neem or Agadirachta; it has abruptly pinnate leaves, the leaflets dotted and unequally lobed, very fragrant and well known as used, under the name of curry-pāle, to season the curries of the country. The small whitish flowers had passed before our visit, but the berries were ripening, about the size, shape, and colour of a sloe; and some of the natives tried to persuade me that they were nice. They are very mucilaginous, and with a peculiar aromatic flavour; but I seldom cared to taste them.

Atalantia monophylla I did not myself find, but it was brought to me from the lower slopes. It is a pretty and very fragrant shrub, very appropriately named by the natives runnimboo, *i.e.,* wild lime. A Capparid with small broadly ovate subsessile leaves, each set between two long stipulary thorns, is a very striking and pretty little shrub, but I had no opportunity of examining the inflorescence, and of identifying it.

An elegant tree, with alternate broad lanceolate dark-green leaves, and dark-coloured ovoid fruit like a large plum, is put down doubtfully by Graham as *Laurus rumphii.* I found it in one spot only, far down a steep ravine; and in the same neighbourhood was growing *Myristica amgdalina,* with fruit like a small rusty-coloured peach. It is, in fact, a wild nutmeg. *Musœnda frondosa* I have found growing wild on the plateau of Matheran; but in May its

handsome orange flowers and white foliaceous calyx segments began to show themselves down the southern ravines. It should have been earlier mentioned with the other Cinchonaceæ. There were yet several others of the same order which I failed to identify. I even found a coffee-bush growing very well, though quite neglected, in a private garden. I found *Thunbergia grandiflora* and *Trichosanthes palmata* growing luxuriantly, but under circumstances which left it doubtful whether they were indigenous or introduced.

Lobelia excelsa grows, though not abundantly, at the period of our visit. It is so remarkably acrid, that the mere gathering it affected the throat, making me cough, and long after I had handled it I made my eyes smart considerably by touching them.

Of Gentianaceæ, *Canscora diffusa* was the only representative that I found, with its pretty, small, rose-coloured blossoms; but it was not by any means in a flourishing condition. There is a tree of no great size, but which from its frequency, and from its peculiar leaves, rather large, cordate paltate, attracts the eye. It is *Osyris peltata*, which I had never met with elsewhere, the only representative of the Santalaceæ which I found here. The small berry is covered with a peculiar clammy substance.

Among the abounding climbing plants, a Pergularia attracted me by its follicles, which were discharging its feathered seeds; also a Smilax, by its graceful leaves. But they were neither of them in season, so that I did not see the blossoms. Orchises grow abundantly, as in other damp places along the western coast of India, on the trees, but, so far as I could judge, not in any great variety. A wild plaintain (*Musa textilis*?), Runkhela is the native name, is quite common. It is a stemless plant, or almost so, but its large fresh green leaves strike the eye; the fruit, though small, is not bad when quite ripe; and the lower classes of natives on the hills are said to eat the root or bulb in seasons of scarcity. When the rain began to fall about the beginning of June, it brought out several varieties of Aroideæ. *Arum bulbiferum* began to show itself abundantly, but is not the one of its order likely to attract the most attention.

I one afternoon found an Arum springing up (without leaves at this season), the whole with a peculiarly livid appearance, mottled-green and purple; the scape measuring one foot eight inches to the origin of the spathe, which was eight and three-quarter inches; the spadix, extending far beyond the spathe, about fourteen inches. As I carried it home, I noticed the most abominable fetor, and soon discovered that I was carrying the source of it in my hand. I do

not know a more fetid plant; and instances came to my knowledge of persons sending out to have the jungles around their houses searched for some carrion which they supposed must be there infecting the air, little suspecting that the stench was caused by this Arum (*Dracontium polyphyllum*), which they passed by unnoticed. As in many others of the tribe, the leaves come up subsequently. If this plant repels notice, another of the same order attracts it.

Arum Murrayi, known to the English visitors as the Cobra Lily. It is a great pity that in so many instances our English visitors have managed to give such inappropriate names to the plants. When I was told of the "Cobra Lily," I naturally, at first, looked out for a lily. After the first heavy showers, it springs up in every direction; first, the pretty inflorescence, soon followed by the long, petioled, digitate leaves. The scape averages a foot high; the spathe, which is nodding, is white, more or less suffused with crimson; it well deserves the epithet of "a beautiful plant," given to it by Mr. Graham. The roots are tuberous, and it bears transplanting exceedingly well. Many of this order are viviparous.

Another very curious plant is rather abundantly brought up by the rains: that is, *Curcuma pseudo-montana*, belonging to the order *Scitamineæ;* the scapes only coming up now. They are about a foot high, the lower tracts broad, rounded, green, edged with red, the upper ones forming a beautiful corona, of a rose-madder tint. Between the bracts, and equalling them in length, are the flowers, two or three together, bright gamboge yellow; corolla subringent. The anther cells, horned at bottom, are sessile on the upper lip, and the long, filiform style passes between them, bearing a curious peltate, fringed stigma; all of which repays the most minute examination. The leaves of this plant spring up later in the season. The tubers contain a large amount of starch, and are boiled for food by the natives, especially in times of scarcity.

And now as to the *Cryptogamia*, the end of the dry season was not the best time to collect any of them. Of ferns there are said to be fourteen or fifteen species in Matheran; but I found but very few. The Silver Fern, *Cheilanthes farinosa*, is widely distributed, presenting its withered fronds everywhere; and it was surprising to notice how, immediately after the first good shower, these same withered fronds regained their freshness, and stood up in all their silvery beauty. *Angiopteris erecta*, in certain spots, grew to a

large size. *A. pleopeltis* grows upon some of the old trees. *Adiantum lunulatum*, and a few others of the same species; one small one with a very sweet scent, like wood-ruff; and other ferns also showed themselves. But, in truth, they were all in too immature a stage for me to feel any confidence in their identification, when not of the very commonest kinds. And so also of the mosses, which, therefore, I will also pass by without further notice.

And thus I must bring to a close the record, perhaps already too much spun out, of our very pleasant holiday; not, certainly, the record of the thousandth part of what might have been observed during the period. For if we have gained much instruction, yet how much was lost for want of noting it down at the time—how much observed that I failed to understand aright, or to identify; how much more which altogether escaped observation. Yet surely enough has been gathered to show that here in India, as elsewhere, we are surrounded by objects of deepest interest, if there be but the open eye, the loving heart to take them in.

On the 12th of June, in pouring rain, we were once more on the Ghat, now on our homeward journey—all changed, but all in new beauty, and all rejoicing in God's precious gift of the rain. Streams and waterfalls full, and wonderful effects of "cloud beauty" adorning hill and distant plain. Our sixty days had not been mis-spent, and we were once more prepared to take up the somewhat different duties of cantonment life.

OWEN'S THEORIES OF LIFE AND DEVELOPMENT.*

MR. OWEN has now brought his great work on the Anatomy of the Vertebrates to a completion, in a third volume, which comprises the muscular system of the mammalia, their nervous, dental, absorbent, circulatory, respiratory, and other systems, and is full of important and interesting matter; but what will excite the largest amount of immediate attention, is the final chapter, entitled, "General Conclusions," and setting forth the results of his speculations on the origin and nature of life, and of the diversities of species and forms. He tells us that "the great master, in whose dissecting rooms, as well as in the public galleries of comparative anatomy, he was privileged to work, held that species were not permanent, and taught this great and fruitful truth, not doubtfully, or hypothetically, but as a fact established on a wide and well-laid basis of observation, by which, indeed, among other acquisitions to science, comparative osteology had been created. Camper and Hunter had suspected that species might be transitory; but Cuvier, in defining the characters of his Anoplotherium and Palæotherium, etc., proved the fact." Mr. Owen then alludes to the celebrated discussions between Cuvier and Geoffrey St. Hilaire, and states that he considered the main questions in dispute to be the following:—"Unity of plan, or final purpose, as a governing condition of organic development? Series of species, uninterrupted, or broken by intervals? Development by epigenesis, or evolution? Primary life, by miracle, or secondary law?"

Further study led Mr. Owen to reconsider Cuvier's conclusions, and when he arrived at the conception of "the community of organization," "associated with and dominated by that of adaptation to purpose, the step was plain—to him inevitable—to the conception of the operation of a secondary cause of the entire series of species, whether of plants or of vertebrates, or other groups of organisms, such cause being the servant of predetermining intelligent Will." In the repetition of similar parts he recognized an analogy to "the repetition of similar crystals, as the result of polarizing force in the growth of an inorganic body;" and, finally, he arrives at the belief, that existing species are descended from those which preceded them. As to how this took place we get from him no clear indications, but frequently encounter a perverse misrepresentation of

* "On the Anatomy of the Vertebrates." Vol. iii. Mammals. By Richard Owen, F.R.S., Superintendent of the Natural History Department, British Museum, Foreign Associate of the Institute of France, etc. (Longmans.)

the Darwinian views. To say "that Palæotherium has graduated into Equus by 'Natural Selection,' is," he informs us, "an explanation of the process of the same kind and value as that which has been proffered of the mystery of secretion," such as "appetency of the liver for the elements of bile," etc. No one who takes the trouble to understand what Mr. Darwin has plainly said could make such erroneous assertions. What Herbert Spencer has appropriately termed the "survival of the fittest" is a fact rather than a theory. Darwin's phrase "Natural Selection" is not so happy, though it will do to convey the same idea. There can be no "selection," in the sense of choice, effected by the operation of unconscious causes. Living beings may be sorted out, some for destruction, others for preservation, by natural causes, as blindly as running water sorts out and deposits large pebbles and fine sand, and if the word selection is used to explain the process, it can only be employed in a somewhat metaphorical and restricted sense. But when science confines itself to secondary causes, it does not necessarily place itself in opposition to final causes, or to the pervading agency of a first cause. That collection of forces, commonly called "nature," may work blindly, and at the same time be the instrument of intelligent Will, just as a steam-engine has no consciousness of the purposes to which man directs its powers.

Although Mr. Owen objects scornfully to the phrase, "Nature has selected the mid hoof, and rejected the others," in the process of converting Palæotherium into the horse, there is really no foundation for his strictures, as the most devout believers in theistic philosophy do not conceive of polar forces as knowing what they are about, but simply as performing the special tasks which the ultimate Intelligence and Volition has determined they shall accomplish.

All who are conversant with the history of science know perfectly well that certain believers in development theories have not recognized any final cause, or any first cause in their speculations, but there is no occasion for Mr. Owen, by way of inferentially throwing obloquy upon others, to tell us that "it may be a glorious weakness for him to discern evidence of the Deity that shapes our ends." The great and broad tendencies of science in this country are undoubtedly theistic, and if attempts are made to induce mankind to confine their thoughts entirely to secondary causation, they can only be partially and temporarily successful, in particular states of society, and when an active conflict is going on between new truths and old forms of belief.

It is not easy to understand what Mr. Owen believes with respect to the rapidity or slowness with which the transmutation of species have been effected. In one passage he alludes to the fact that modern horses sometimes come into the world with the supplementary hoofs possessed by their ancestors, as opposed to the idea that species are transmuted by minute and slow degrees, while in another he gives prominence to those discoveries in geology which have overthrown cataclysmal theories, and have supplied the links between creatures supposed to have been completely separated from each other by imaginary revolutions of a violent kind. That new species *may* arise suddenly, or do so occasionally, is quite consistent with the belief that they more often result from slow and progressive modifications, which seem to be evidenced by the geological record.

Mr. Owen accepts Mr. Darwin's "battle of life" as helping to determine the extinction of species, but "fails" to discover its bearing on the origin of species, though if any species are produced by slow changes extending over large periods of time, the result of a life battle at any epoch of the process must obviously contribute to determine what species may thereafter arise. If all the creatures in process of modification from the Palæotherium to the horse had lost their battle, and been killed, their equine descendants could not have come into being, except as new creations, or through some other ancestry. "Natural Selection" cannot, of itself, originate anything, nor does Darwin pretend so; it merely encourages or discourages, preserves or destroys, those variations from pre-existing patterns, which are useful under the circumstances, and capable of hereditary descent.

No one has yet discovered the laws which regulate the changes "species" are able to undergo, or can tell the precise conditions or extent to which variation may be combined with hereditary descent. Some of the transitory forms which possess sufficient permanence to be called species, may be, and indeed seem to be, much more liable to modification than others, and we may doubt whether Mr. Owen could offer valid reasons for his assertion that "all species co-existing with the actual specific form of *Homo* will, with him, be immutable, or mutable only as he may be." Mr. Wallace has shown that man's mental and moral qualities make him independent of the influences operating in natural selection to an extent that cannot be predicated of any of the lower animals. Human intelligence overcomes disadvantages of climate, or brings food to the most barren spots, while human society exhibits mutual helpfulness in a ratio which rapidly increases in progressive communities, and immea-

surably transcends anything of a similar nature which the higher gregarious animals can show. By placing man in a separate category, the "Archencephalic," Mr. Owen has marked so conspicuous a difference between him and the lower animals that it could only be in a mood of logical blunder that he could have penned the passage we have just cited.

Why Mr. Owen should oppose "Derivation"—by which he means nothing more than descent with variation—to "Natural Selection," it would be difficult to guess, unless it were for the pleasure of differing from a greater and more comprehensive thinker than himself—a feeling which is also curiously manifested in the rude observations directed against Lyell, whose splendid services he scarcely notices. "Derivation," he informs us, "holds that every species changes, in time, by virtue of inherent tendencies thereto." "Natural Selection," he adds, "holds that no such change can take place without the influence of altered external circumstances educing or selecting such change." We may safely challenge Mr. Owen to produce fairly-selected passages from Mr. Darwin's writings justifying this erroneous explanation of what is meant by "Natural Selection." In the "Introduction" to the "Origin of Species," Darwin carefully and emphatically guards against the blunder which Mr. Owen makes him commit. He says, "Naturalists continually refer to external condition, such as climate, food, etc., as the only possible cause of variation. *In one very limited sense*, as we shall hereafter see, this may be true; but it is preposterous to attribute to mere external conditions, the structure, for instance, of the woodpecker, with its feet, tail, beak, and tongue so admirably adapted to catch insects under the bark of trees."

Although Mr. Darwin's writings are not at all difficult to understand, he is not cautious enough in individual expressions, and his meaning can only be safely inferred by looking to the context as well as to particular passages. In the fifth chapter of the "Origin of Species," he speaks of deviations of structure as in some way due to the nature of the conditions of life to which the parents or their remote ancestors have been exposed, but he immediately proceeds to explain and limit this sort of influence, and to show that "the same variety may be produced under conditions of life as different as can well be conceived." This fact he considers to show that little weight can be assigned to the *direct* action of life-conditions, though their indirect action, through the reproductive system, may be great. "Our ignorance of the laws of variation,"

Darwin rightly affirms to be "profound," and all that he claims for natural selection is a tendency to favour or disfavour the variations that occur from all the causes, whatever they may be, which are capable of inducing them. Exactly what Mr. Owen means by "*educing*" a variation, we do not know. A variation may be induced or produced, but we do not see how natural selection could *educe* it, though it might "select it" in the manner explained.

Pursuing his explanation of "Derivation," Mr. Owen says, it "sees among the effects of the innate tendency to change, irrespective of altered surrounding circumstances, manifestation of creative power in the variety and beauty of the results, and in the ultimate forthcoming of a being susceptible of appreciating such beauty, evidence of the preordaining of such relation of power to the appreciation. 'Natural Selection' acknowledges, that if ornament or beauty in itself should be a purpose in creation, it would be absolutely fatal to it as a hypothesis." Upon this passage we may remark, that there is no proof that animals possess any "*innate* tendency to change, irrespective of altered surrounding circumstances." So far as science knows the facts of nature, it would assert that if the same materials are brought together in the same proportions, in precisely the same way, and under exactly similar conditions, they will uniformly and invariably lead to precisely the same results.

To suppose that animals or vegetables are gifted with "innate tendencies to change," quite irrespective of circumstances, is to suppose that they are endowed with a metaphysical abstraction—for an "innate tendency" is nothing more; and such an explanation is no better than the old mode of accounting for the purgative powers of jalap, by affirming that the drug in question possessed a "purgative principle." Should we thank any chemist for telling us that a lump of sugar had an "innate tendency" to dissolve in water, or to burn in fire, or to decompose in sulphuric acid? It is enough if he informs us that sugar does such things; and if he were to add that the cause of the actions is a tendency thereto sticking to the sugar, we should tell him that our laughter was the consequence of our "inherent tendencies" to perceive a joke.

When animals or vegetables "sport," or produce descendants strikingly differing from their parents, we may be sure that some actual facts, and not mere metaphysical abstractions, have led to the change, though we may be perfectly ignorant of what those facts are.

Mr. Owen is not entitled to place his "Derivation" and "Natural Selection" in opposition, as he does in the concluding part of the sentence just cited. Mr. Darwin says, "As Natural Selection works solely by and by for the good of each being, all corporeal and mental endowments will tend to progress towards perfection." Surely there may be as much "pre-ordination" in this as in Mr. Owen's "Derivation." "'Natural Selection' does [*not*] acknowledge that if ornament or beauty in itself should be *a* purpose in Creation, it would be absolutely fatal to it as a hypothesis." It asserts that the world is not filled with beauty simply for the delight of man. The beauty arises from the essential nature of the system, and man appreciates it because he is in harmony with it. Things that existed before man came upon the earth, and which now exist in regions where he cannot possibly have any cognizance of them, were and are quite as beautiful as those with which he is made acquainted.

In further contrasting his "Derivation" with "Natural Selection," Mr. Owen continues: "Natural Selection sees grandeur in the view of life, with its several powers, having been originally breathed by the Creator into a few forms, or into one. Derivation sees therein a narrow invocation of a special miracle, and an unworthy limitation of creative power, the grandeur of which is manifested daily, hourly, in calling into life many forms by conversion of physical or chemical into vital modes of force, under as many diversified conditions of the requisite elements to be so combined." Now, there is something much like charlatanry in this sentence, for neither "Derivation" nor "Natural Selection" are competent to settle the origin of life. Mr. Owen may be right or wrong in believing that life is continuously originating by conversion of physical and chemical forces into vital forces; and Mr. Darwin may be right or wrong in assuming that life was originally breathed into a few forms, or into one. The present state of knowledge does not justify positive assertions on these subjects, for science does not anywhere approach a beginning of the system of things in which we live, and of which we form a part. It is absurd to be shocked and scandalized at heterogenesis as if the idea were essentially immoral; but it is not philosophical to affirm its truth while we are extremely ignorant of the size, quantity, and visibility of the minutest germs of life. If heterogenesis prove true, "Natural Selection" must play its part quite as effectually as if "Pangenesis" were correct.

Mr. Owen, having alarmed the orthodox by supporting one of

their bugbears, heterogenesis, makes up for the offence by imparting a goodness—we ought to say "goodiness"—to his "Derivation," which "Natural Selection," according to his version of it, does not possess.

He exclaims "'Natural Selection' leaves the subsequent origin and succession of species to the fortuitous concurrence of outward conditions. Derivation recognizes a purpose in the defined and pre-ordained course, due to the innate capacity or power of change by which homogenously-created protozoa have risen to the higher forms of plants and animals." We have already exposed the fallacy of the statement that "Natural Selection" makes any origin of species to depend upon the mere concurrence of "outward conditions," and Mr. Owen does not make his misrepresentation any better by introducing the word "fortuitous."

The idea of plan and purpose is not necessarily connected with heterogenesis, or excluded from Natural Selection. In fact, many spontaneous generationists have denied purpose altogether, and have excluded Intelligent Will from their schemes of the universe. The grounds on which we infer design, purpose, and plan are not affected by either speculation *in the way* in which Mr. Owen imagines, for if "Natural Selection" be a fact, and if it operates, as Mr. Darwin supposes, in the progressive improvement of the beings on which it acts, it must supply a strong argument in favour of the belief in an Intelligent and Beneficent First Cause, and in leading us to regard law as predominating over anything that can be called "fortuitous," or dependent upon chance.

At the close of Mr. Owen's laudation of his "Derivation," he enters upon the question of epigenesis, or evolution, and he treats the pre-existence of germs and evolution as *logically inseparable* from the idea of the origin of species by primary miraculously-created individuals.

If he had stated that certain schools had connected the two things specified, he would have been quite right, but those who now believe that all living beings are the lineal descendants of pre-existing beings are certainly not *logically* obliged to affirm that the germs from which they sprang grew into the adult form by what is called evolution, and not by epigenesis. It was not unnatural for older observers to suppose that germs contained in miniature all the forms which were afterwards to be manifested, but this is not necessary even to Darwin's startling hypothesis of pangenesis, which, without telling us what germs are, conceives that each part of an organism contributes the germs of the same, or of a similar part in its

descendants. All that we know of a "germ" is that it can grow under appropriate conditions into something more or less like the parents from which it sprang. It arranges new matter in definite form, but not necessarily, or probably, by adding particles so as to enlarge miniature forms pre-existing in it.

Mr. Owen adopts Pouchet's hetrogenesis, upon which sufficient comment has been made in our pages, and he says, "it seems to me more consistent with the present phase of dynamical science, and the observed gradations of living things, to suppose that sarcode or the protogenal jelly-speck should be formable through concurrence of conditions favouring such combination of their elements, and involving a change of force productive of their contractions and extensions, molecular retractions and repulsions—and that sarcode has so become, from the period when its irrelative repetitions resulted in the vast indefinite masses of eozoon, exemplifying the earliest process of formifaction, or organic crystallization—than that all existing sarcodes, or protogenes are the result of genetic descent from a germ or cell due to a primary act of miraculous interposition.

"Some, accepting the latter alternative, teach that while generations of the first created sarcode have descended to us unchanged, from the period of the Laurentian limestone, other sarcodal offspring have developed and improved, or have been selected into all the higher forms of living beings. I prefer, however, while indulging in such speculation, to consider the various daily nomo geneously-developed forms of protozoal or protistal jellies, sarcodes, and single-celled organisms, to have been as many roots from which the higher grades have ramified, than that the origin of the whole organic creation is to be referred, as the Egyptian priests did that of the universe to a single egg."

The terms "nomogenous" and miraculous are only contrasted by a limited school of theologians—law-made and miracle-made can only differ in the minds of those who do not recognise to the full extent, uniformity of operation and unchangeableness of the Divine will. It is foreign to our scope and purpose to enter upon questions that belong to theology rather than to science, and we cannot attempt to follow some portions of Mr. Owen's remarks, and upon which grave discussion is certain to arise; but we may say, that without accepting, and, indeed, while objecting to some of his illustrations, we agree with him that there is no satisfactory ground for the common distinctions between material and immaterial forces.

While we do not know what matter is, we are not in a position

to dogmatize on this subject. Force, and centres of force, we can recognize; but how we think or feel, and what are the causes of those actions, we know not, and are not helped to guess by any theories of vibrations of particles, or such-like operations. The physiologist is entitled to pursue his own study unhampered by the theologian. In due time, all that is scientifically ascertained to be true will be welcomed by theologians, and a long, wearisome conflict will cease. But this happy issue can only arrive when theologians feel the duty of studying the universe in which they live, and which is the expression of Divine thought. By life we can strictly mean nothing more than a series of manifestations of forces we do not understand. How it began, we can only infer from information at present very imperfect and incomplete; but if "daily nomogenously-found protistal jellies" are roots from which higher grades ramify, we may be permitted to wonder how it is the ramifying process is not daily discernible. When missing links are wanting in the Darwinian hypothesis, we may refer to the gaps in the records we possess; but, if protistal jelly is daily passing into higher forms, we might expect to witness the operation to an extent which no one has yet pretended to do. We are only at the beginnings of knowledge in these matters, and it is a pity that our philosophers should so frequently expend time in squabbling with each other, that might be more profitably employed in patient research. To Professor Owen the science of our time is deeply indebted. Would it be less so if he acted with greater liberality and fairness to investigators whose claims to respect are not inferior to his own?

ASTRONOMICAL NOTES FOR JANUARY.

BY W. T. LYNN, B.A., F.R.A.S.

Of the Royal Observatory, Greenwich.

(With a Tinted Plate.)

Mercury is in superior conjunction with the Sun on January 3rd. He will arrive at greatest eastern elongation on the 3rd of next month, and will therefore be visible in the evening by the end of January, but low in the heavens, being in the constellation Aquarius. On the 31st day, he will set at 6h. 25m.

Venus is a morning star, rising on the first day at 5h. 39m. A.M., and on the last day at 6h. 32m. During the latter part of the month she will be in the constellation Sagittarius.

MARS is this month well placed for evening observation. He rises on the first day at 8h. 33m. P.M., and on the last at 6h. 1m.; and is throughout in the constellation Leo.

JUPITER continues to be conspicuous during the early part of the night. He sets on the first day at 11h. 50m. P.M., and on the last day at 10h. 17m.; being on the meridian at 5 o'clock in the afternoon on the 12th, and at 4 o'clock on the 30th.

PHENOMENA OF JUPITER'S SATELLITES.—The following list contains, as before, all those phenomena of the satellites which will be readily and conveniently observable in the evening:—

DAY.	SATELLITE.	PHENOMENON.	MEAN TIME.	
			h.	m.
January 2......	I.........	Occultation, disappearance	8	55
„ 3......	I.........	Transit, ingress	7	26
„ 3......	I.........	Transit, egress	8	21
„ 3......	II.........	Occultation, disappearance	10	31
„ 4......	I.........	Eclipse, reappearance......	6	57
„ 5......	II.........	Transit, ingress	5	37
„ 5......	II.........	Transit, egress.............	8	11
„ 7......	III.........	Occultation, disappearance	10	9
„ 10......	I.........	Transit, ingress	8	2
„ 10......	I.........	Transit, egress.............	10	18
„ 11......	I.........	Occultation, disappearance	5	22
„ 11......	I.........	Eclipse, reappearance......	8	53
„ 12......	II.........	Transit, ingress	8	18
„ 14......	II.........	Eclipse, disappearance ...	5	13
„ 14......	II.........	Eclipse, reappearance......	7	33
„ 17......	I.........	Transit, ingress	10	0
„ 18......	I.........	Occultation, disappearance	7	21
„ 18......	III.........	Transit, egress	7	32
„ 19......	I.........	Transit, egress	6	45
„ 21......	II.........	Occultation, reappearance	7	48
„ 21......	II.........	Eclipse, disappearance ...	7	50
„ 25......	III.........	Transit, ingress	8	50
„ 25......	I.........	Occultation, disappearance	9	20
„ 26......	I.........	Transit, ingress	6	29
„ 26......	I.........	Transit, egress	8	44
„ 27......	I.........	Eclipse, reappearance......	7	14
„ 28......	II.........	Occultation, disappearance	7	59
„ 29......	III.........	Eclipse, reappearance......	6	17
„ 30......	II.........	Transit, egress	5	44

The eclipses will take place on the right hand side of the planet as seen in an inverting telescope. At the disappearances in the shadow, the first satellite will not be visible, being behind Jupiter: its reappearances will be seen about half a diameter of the planet from him. The second satellite will disappear close to the planet, and reappear at about a diameter's distance from him. The third satellite will disappear at the distance of about half a diameter, and reappear at that of rather more than a diameter of the planet from him. The fourth satellite will neither suffer eclipse, nor pass either behind or in front of Jupiter.

OCCULTATIONS OF STARS BY THE MOON.—Eight of these may be seen this month, at early hours of the night, including those of the bright stars Regulus and Aldebaran, on the 1st and 23rd respectively.

DATE.	STAR.	MAG.	DISAPPEARANCE.		REAPPEARANCE.	
			MEAN TIME.	V.	MEAN TIME.	V.
			h. m.	°	h. m.	°
Jan. 1	Regulus	1½	9 28	46	10 25	211
„ 23	θ^1 Tauri	4½	4 34	51	5 39	276
„ 23	θ^2 Tauri	4½	4 41	27	5 31	299
„ 23	B. A. C. 1391	5	5 40	75	6 53	270
„ 23	Aldebaran	1	8 49	106	10 5	314
„ 24	115 Tauri	6	5 29	14	6 12	298
„ 24	119 Tauri	5½	8 14	129	9 10	238
„ 24	120 Tauri	6	8 48	112	10 0	274

The angle V is, as usual, counted from the highest point in altitude in the direction of the right hand, as seen in an inverting telescope.

THE MOON.—The Moon is in her last quarter at 6h. 22m. A.M. on the 5th day; New, at 6h. 53m. P.M. on the 12th; in first quarter at 12h. 26m., midnight, on the 20th; and Full at 1h. 30m. A.M. on the 28th.

On the night of the 27th she will suffer partial eclipse, the greatest magnitude, however, of which will be less than half (0·45) her diameter. At Greenwich, the first contact with the penumbra will take place at 11h. 18m.; and with the shadow at 12h. 29m.; middle of the eclipse, at 1h. 38m. A.M.; last contact with the shadow, 2h. 47m.; with the penumbra, 3h. 58m.

ENCKE'S COMET.—We are now able, as we believe, to give nearly a complete account of the observations which were made in the

northern hemisphere of this comet, at its return last summer. Dr. Winnecke appears to have been the first person who succeeded in seeing it, on the 14th of July, at Karlsruhe. He had no means of doing more than estimating its approximate position by the neighbouring stars. It was excessively faint, and resembled a faint, uniform nebula, about 1½′ in diameter.* Professor D'Arrest, at Copenhagen, detected it on July 20, but, by reason of its extreme faintness, could not succeed in getting an observation until the 26th.† Both Dr. Förster, at Berlin, and Professor Karlinski, at Cracow, obtained a series of observations, commencing on July 24, those at Berlin being continued by Herr Becker until August 25.‡ But the most complete set seems to have been made by Professor Bruhns, and his assistant, Herr Vogel, at Leipzig. They just succeeded in recognizing it on the 22nd, but the actual observations commenced on the 24th, and were all made by Vogel, who also executed two drawings, copies of which are represented in our engraving. In making both, the comet was seen under a magnifying power of 144. The following are some of Vogel's remarks§ :—

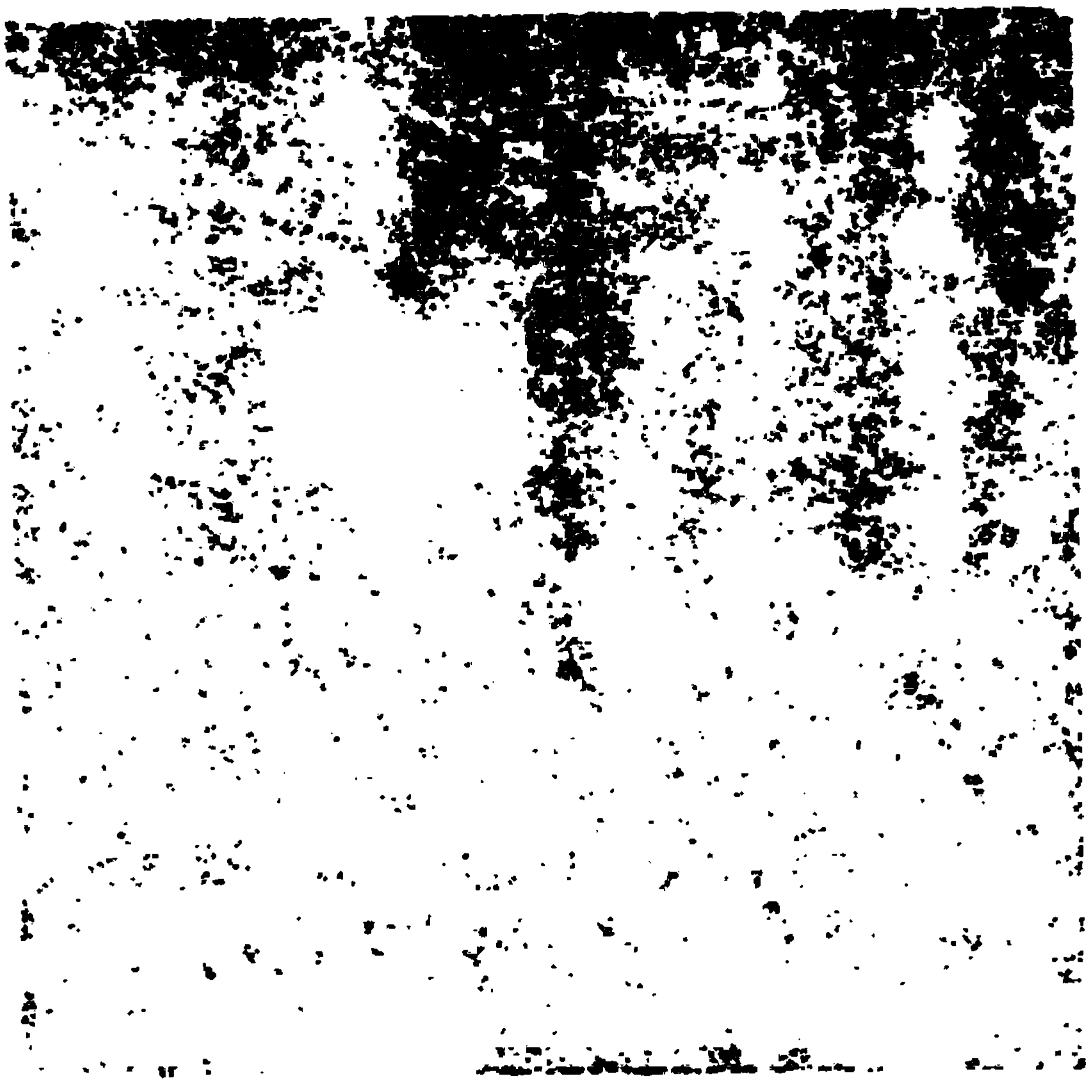
"July 24.—The comet very faint, round, a very little brighter in the centre; diameter, 3′.

"Aug. 13.—Very bright, and easy to observe." (The drawing represented in Fig. 2 was made.) "The brightest nucleus-like condensation was eccentrically placed in the south-preceding part of the comet. Besides the condensation concentrically surrounding this brightest part, there were also visible two bright streaks, meeting in the centre." (These are scarcely perceptible in the drawing.)

"Aug. 20.—Three envelopes surrounding the comet. The interior and brightest, round, about 50″ in diameter, eccentrically situated within the next outer, which was also round, and about 2′·7 in diameter, whilst the third was tail-like, and very faint. From the first proceeded the two brighter streaks which were noticed on the 13th, one fainter and broader than the other, but both considerably broader than on the 13th." (The drawing was made, of which Fig. 3 is a copy. It was difficult to represent the streaks faithfully.)

"Aug. 26.—The comet was well seen, although the sky was covered with thin cirri. Stars of the 8th magnitude near it were not visible.

* "Astronomische Nachrichten," No. 1707. † Ibid, No. 1708.
‡ Ibid, Nos. 1707, 1711, and 1712. § Ibid, No. 1722.



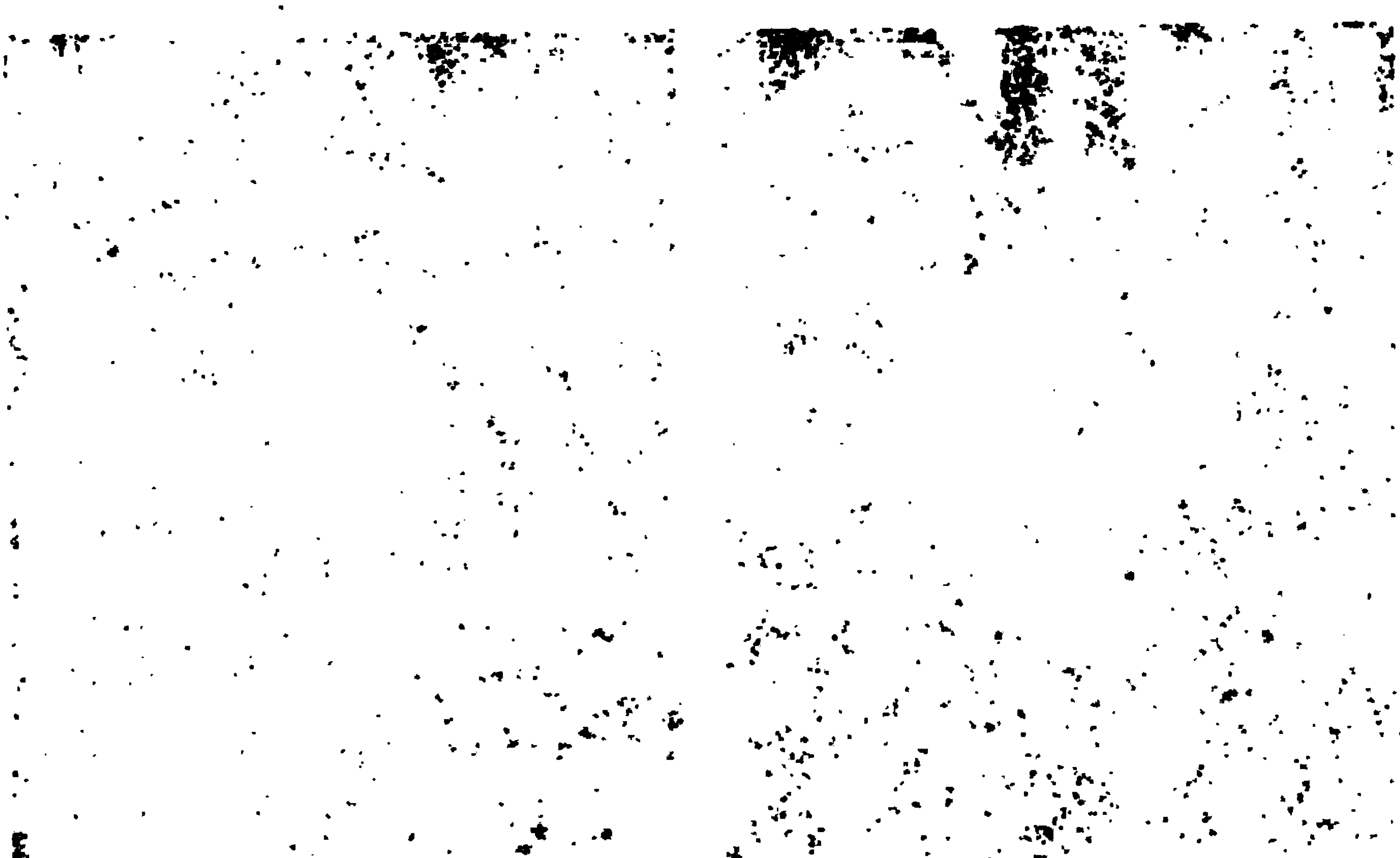


FIG. 1.
BRORSEN'S COMET, MAY 14, 1868.
(Drawn after Vogel.)

FIG. 2.
ENCKE'S COMET, AUG. 13, 1868.

FIG. 3.
ENCKE'S COMET, AUG. 20, 1868

(Drawn after Vogel.)

"Aug. 27.—The comet was seen between clouds, very bright, diameter of the nucleus, 20″ to 30″, whilst that of the whole object was from 3′ to 4′. The nucleus was equal in brightness to a star of the 7th magnitude.

"Sept. 3.—State of the atmosphere, very favourable. The comet was well seen; its nucleus equal to a star of the 7th magnitude."

As astronomical time is used, and the comet was seen in the early morning, the above dates each correspond to that of the following day in civil reckoning.

Dr. Schmidt, the indefatigable Director of the Observatory at Athens (who remarks that the new comet discovered last June was the sixtieth which he had observed), has also communicated * a valuable series of observations of Encke's comet at its late apparition. He saw it first with certainty on July 27, when he says that there was scarcely any perceptible trace of condensation at the centre, which remark is very similar to that of Vogel, about the same time. From August 20 to 29, Schmidt obtained a considerable number of observations, but, owing to the comet's very low position in the sky, he does not attribute any great accuracy to them. The condensation was then well-marked and bright, the coma very small, and the tail (which was first perceived on August 24, twenty-two days before the perihelion passage, but does not seem to have been seen by Vogel), quite small, very faint, and straight. On August 20, his description of it agrees generally with the drawing of Vogel, copied into our Fig. 3. The circumference was elliptical, the condensed light in the part turned away from the Sun, and the faint (following) extension in that turned towards him. The boundary was best defined on the side opposite to the Sun (the left-hand side in the figure), and it was there that the tail afterwards showed itself. The appearance was similar to that drawn by Struve at Dorpat, on Nov. 30, 1828, but the comet was then much brighter, being equal to a star of the sixth magnitude, and just visible to the naked eye. Schmidt made several measurements of the diameter of the coma, which appeared to indicate that its size is connected with the comet's distance from the Sun. Thus he found it considerably smaller in August, 1868, when within the orbit of Venus, than in December, 1861, when it was observed by him outside the Earth's orbit. But on July 27, 1868, when the distance from the Sun was the same as the Earth's, the diameter of the coma was only a very little less (about fifteen times that of the

* "Astronomische Nachrichten," No. 1725.

Earth), than on December 19, when the comet was also just in the circumference of the Earth's orbit. A similar conclusion appeared to be deducible from comparisons of the observations made in other years.

No one in England has, so far as we are aware, succeeded in seeing this comet at the late appearance. Mr. Hind has kindly informed the writer, that although he tried for it several times, he was continually baffled by misty mornings, often after promising evenings. The same cause, doubtless, prevented others from seeing it. The writer believes that the only person in the British islands who saw it was Mr. Birmingham, of Millbrook, near Tuam, Ireland. That gentleman, after several ineffectual attempts, from bad weather, succeeded in detecting it on the morning of August 15, in the same field of view with τ Geminorum, and nearly in a line with two small stars. It was exceedingly faint, but he was able to scrutinize it with a power of 200, on a telescope of 4½ inches aperture of object-glass. "I think," he says,* "I could perceive a luminous concentration behind the centre of the comet, so that the greatest extension of the exterior haze was in the direction of its course. I was not long observing when its motion became obvious, and towards three o'clock the borders of its thin web seemed about to envelope one of the little stars already mentioned. Whether it actually did so or not, the vibrations of the instrument prevented my ascertaining; but the nucleus passed clear, to my considerable mortification." Mr. Birmingham again observed the comet on the morning of August 23, and this time actually saw it pass over a small star at about a quarter before three o'clock. "The great brightness," he writes,† "when I first saw it, was situated, as well as I could judge, at about a third of the comet's diameter from the edge; and it is worthy of remark, that the cometary matter was here just dense enough to become illuminated itself by the star, whose light it diffused to a certain extent all round, in the manner of a semi-transparent screen. As the star approached the edge, however, the diffused light was gathered up to a point, which shone with great brilliancy while it was still within the limits of the haze." The comet will return again to perihelion early in the year 1872.

Brorsen's Comet.—The remarks made by Professor Bruhns and his assistants, Engelmann and Vogel, on this, the other periodical comet of last year, will also, perhaps, possess some interest for our readers, and will contribute to the knowledge of its history, for

* "Astronomical Register," No. 69, p. 211.

† Ibid., No. 70, p. 229.

comparison with subsequent appearances. Herr Vogel also made a drawing of this comet (of which Fig. 1 in our engraving is a copy), on May 14, as seen under a power of 144, on a telescope of 8 Paris inches aperture. They are as follows:—*

"April 9. By Engelmann.—Very bright, round, much brighter in the middle, 1 minute in diameter. Nucleus equal to a star of the ninth magnitude.

"April 23. By Bruhns.—Of considerable brightness, 1'·7 in diameter, with distinct nucleus.

"May 2.—Very bright, irregularly round, condensed to a nucleus in the middle. Diameter 3'. (This and all the following observations were made by Herr Vogel.)

"May 5.—Very bright, and easy to observe, notwithstanding the unfavourable state of the atmosphere, and the proximity of the Moon.

"May 8.—Very bright, with tail from 8' to 10' in length. The brighter part of the comet, which was about 50" in diameter, showed appearance of condensation in several places.

"May 14.—Bright, with tail. No nucleus clearly distinguishable, but several bright places in the south-preceding part of the comet. (The drawing represented in our Fig. 1 was made at about 9h. 40m. Leipzig mean time.)

"May 29.—The comet, which was very low in the heavens, appeared faint and diffused, about 5' in diameter."

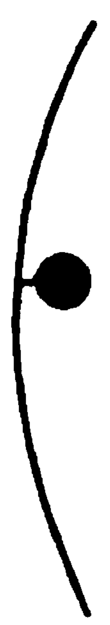
Dr. Schmidt, at Athens, also made some measures of the coma of this comet, with results similar to those in the case of Encke's, referred to above.

This comet, having a period of about 5·6 years, will return to perihelion about the end of 1873.

TRANSIT OF MERCURY.—The transit of the planet Mercury across the Sun's disc, on the morning of the 5th of November last, was well seen in many parts of this country—that is, the latter half of the transit and the final egress. The observation of the egress threw considerable light upon the appearances presented at such phenomena, and, therefore, upon the records of what was seen at the transit of Venus in 1769, recently so ably re-discussed by Mr. Stone, and shown to furnish, when rightly interpreted, so accurate a measure of the Sun's parallax and distance. At the Royal Observatory, Greenwich, both Mr. Stone himself and the writer of these "Notes" distinctly saw, some time before the apparent contact of the limbs of Mercury and the Sun took place, a fine

* "Astronomische Nachrichten," No. 1722.

black thread, or ligament, appear to issue from the planet and touch the Sun's limb, nearly as represented in the woodcut. Doubtless this was the same appearance which was noted at the transit of Venus by the observers at Hudson's Bay, and by Father Hell at Wardhus; but which was not caught by Chappe and his colleagues (excepting, probably, by Pauly) at St. Joseph, or by the observers in Otaheite. It denoted with considerable precision the *real* time of internal contact, the *apparent* time of which was affected by the irradiation of the Sun's light. Several other observers of the late transit of Mercury, who did not catch the formation of the fine line or ligament as the first connection between the limbs of the Sun and planet, noticed a considerable distortion in the form of the latter, as it approached the Sun's edge, which commenced some time before the limbs were apparently in internal contact.



FURTHER REMARKS ON THE TRANSIT OF VENUS IN 1769.—We have a few supplementary remarks to make in reference to Mr. Stone's recent re-discussion of the observations of this transit, of which a pretty full account was offered in our "Notes" for last month.*

The preceding transit, in 1761, had prepared the observers to expect an apparent distortion in the form of Venus, as she passed on and off the Sun's disc. The belief that they endeavoured to observe the time of real internal contact at ingress and egress, as indicated by the first and last connection between the limbs, and not that of their apparent contact, appears to have been the cause that led to Encke's erroneous interpretation of some of the observations. Thus, when Father Hell speaks of the "contactus" at the ingress, as observed by Sajnovics and himself at Wardhus, Encke at once concluded that he must mean the time when the limbs would have been seen in contact had there been no irradiation, not that when they actually were apparently in contact. In like manner, when Chappe, at St. Joseph, speaks of observing the first contact at the egress, Encke concluded that this also was the real contact, which, as we have explained, took place some time before the apparent contact. The case is somewhat different in regard to the

* We take this opportunity of correcting two errors in them. Page 386, line 9, the word "last" should be "least." Page 387, line 3, the word "ceased" should be "commenced." In both places, the phrase referred to is the final breaking of the fine black thread, or ligament, after which solar light was seen to fill up the whole space between his limb and that of the planet.

observations at Otaheite. Cook and Green expected to see an atmosphere surrounding Venus; and as the exterior part of the planet appeared to them a little less dark than the interior, they concluded that the former was really a visible atmosphere inclosing the latter, and, of course, concentric with it. This they call a penumbra, and something similar was noticed by several of the observers of the recent transit of Mercury. Dr. Oppolzer, of Vienna,* estimated it to be of the uniform breadth of about 3″. He thought it might possibly be an optical deception; but, from whatever cause it arose, it was manifestly a totally different phenomenon from the distortion of the planet's form and the formation of the black drop, or ligament, between its limb and that of the Sun, when the irradiated light of the latter, trespassing on the less bright sky and on the dark planet, was first completely divided. Encke and Ferrer were, therefore, evidently wrong in supposing that the contacts of the so-called penumbra and planet with the Sun's limb, as observed at Otaheite, corresponded to the apparent and real contacts (the former affected, the latter unaffected, by irradiation) of the limbs of the Sun and planet. The great length of time which was said to occur between the two (Cook and Green making it 60 and 40 seconds respectively) might of itself have led to some suspicion as to the justice of this interpretation. Ferrer did, indeed, carefully collect all the intervals between the apparent contacts and the formation or rupture of the black drop, which, when the observations made at stations where only the ingress or egress separately could be seen are taken into account, are very numerous; yet this idea, apparently so obvious, never seems to have occurred to him.

At the meeting of the Royal Astronomical Society, held last November, a letter was read from the American astronomer, Professor Newcomb, in which, whilst assenting to all the rest of Mr. Stone's interpretations, he takes exception to the one relating to M. Chappe's observation of the egress, which he believes to have referred to the formation of the black drop, as he had noted its rupture ("ce point noir . . . . était à sa fin") at the ingress, and doubtless wished to make a corresponding observation at the egress. But Mr. Stone remarked, in reply to this, that he did not doubt that Chappe intended to do so, but that it appears probable from his language (speaking of the sudden establishment of the contact), that he did not succeed in catching it. The late transit of Mercury proves that it was not very easy to catch it; and, as it is at first

* "Astronomische Nachrichten," No. 1726.

extremely narrow, much depends upon the state of the atmosphere, and upon the telescope employed.

Mr. Stone's rediscussion of the transit of 1769 is not only extremely valuable in itself, but will be very useful in furnishing those persons who observe the transits of 1874 and 1882, should it be practicable to observe them at all completely (which is unfortunately not very likely to be the case) with the knowledge of what to look for, and by what means to secure the best result. Should the observations of either of them be successful, we may hope, not merely for further confirmation of recent results (making assurance doubly sure), but perhaps for a knowledge of the Sun's distance, which may be considered true within even smaller limits of error than we must now allow to be possible. As already mentioned, the 1769 transit, as discussed by Mr. Stone, gives a distance of 91,700,000 miles, whilst that deducible from the observations of Mars in 1862 is about 300,000 miles less. The truth, in all probability, lies between these; and there are reasons for believing it to be nearer the former than the latter. At the December meeting of the Society, the Astronomer Royal read a valuable paper on the preparations, which he considers it desirable shortly to commence, for the observations, in different parts of the world, of the 1874 and 1882 transits. The incidental advantages derivable from attempting them would, he remarked, be perhaps as great as the direct advantages of carrying them out, should this be possible.

ASTRONOMICAL NOTES.

LINNÉ.—HYGINUS.—DIAGONAL PRISM EYE-PIECE.

BY THE REV. T. W. WEBB, M.A., F.R.A.S.

In the present state of our knowledge as to the crater *Linné*, anything of a definite character may be considered worthy of record. Whether or no it may have undergone the change which has recently been inferred, and as the writer ventures to think on sufficient grounds, from the observations and drawings of Lohrmann and Mädler, the crater enclosed in the white spot is now, at any rate, an object of such minute dimensions that failure must be expected to wait upon any attempt to grasp it with mediocre

instruments. The 9¼-inch silvered glass reflector in my possession is of a character to deal with it with comparative ease; the defining power which splits γ^2 *Andromedæ* being of course available for most critical lunar examination; but in proportion to the delicacy of the object is the liability to obscuration by atmospheric disturbance; a displacement from irregular refraction, which is little felt in the case of larger features, being fatal to distinctness when the details subtend but a second or two of angular extent. From this cause the opportunities are but few in which a favourable view of Linné is attainable.

On the morning of Nov. 6, in the twilight, between 6h. 30m. and 7h. 5m., I found the air very fluttering, so that the lunar surface was viewed as though it lay beneath agitated water; there were, however, periods when the ripple was less annoying; and behind it there was evidently a state of definition which would have shown the minutest details, could they have been caught at rest. In this state of affairs I studied *Linné* carefully with powers of about 212 and 275. The terminator bisected the ring of *Eudoxus;* the great peak at the W. end of *Aristoteles* was a mere point losing the rays of the setting sun; and a similar speck was seen in the darkness covering the S. part of the *Mare Serenitatis,* doubtless one of the peaks on the ring of *Bessel;* while the three small craters lying nearly in a straight line in the open plain N.W. of *Linné,* of which the two southernmost are marked A and B by Beer and Mädler, stood out near the terminator in conspicuous relief. In this favourable position I at first recognized nothing on the site of *Linné* but an elongated white speck, resembling a hill of small elevation such as I had seen on a former occasion when it was close upon the lunar sunset; a little prolonged attention, however, and an occasiona improvement as to steadiness, enabled me to see, with a precision admitting of no doubt, that it was a small white insulated crater, probably not exceeding one-half the diameter of *Linné* A, its near neighbour to the W.N.W. It had, like the other small craters under this illumination, a narrow ring, of which the side facing the sun, as showing the larger surface, was the more conspicuous; and the internal and external shadows were perfectly visible, though the form of the latter, thrown upon a dusky background, could not be in this state of air quite satisfactorily made out. The little crater was perfectly normal in its aspect, excepting a slight elongation from N. to S., which, though strongly suspected, could not be absolutely verified in so unsteady an atmosphere; it is, however, probably fact, as the larger instruments of Messrs. Key, Bird, and With, on

other occasions, when it was enlightened in the opposite direction, have all confirmed the testimony of my own.

The white ground-marking so conspicuous under high illumination had entirely disappeared, and the grey level seemed to abut directly upon the crater-base on every side, without any noticeable rising or depression. An interesting feature in this observation was the entire absence of any trace of a larger crater, though the angle of illumination was favourable. No previous formation of the kind could have been suspected, at least in this state of the air; and no support could be thus obtained to the idea of change: the altered dimensions alone continued to bear testimony to this effect. That testimony, is, however, sufficiently strong; it being very difficult to imagine how so very insignificant a ring could have been magnified into the comparatively broad and deep cavity of three or four times the diameter alike described and represented by Lohrmann and Mädler, and measured by the latter seven times. It must be matter of regret that the latest testimony borne by one so peculiarly competent to decide the question as Baron Von Mädler himself should be, at least so far as it has been made accessible to the public, of an equivocal nature. From the wording of his paper read before the British Association at Norwich, as printed in the "Astronomical Register," No. 71, it would appear that he fully admits the fact of change, but is yet represented as saying that in 1867 he saw it with the Bonn heliometer, as far as his enfeebled sight would permit, "shaped exactly, and with the same throw of shadow" as he remembered to have seen it in 1831. There is certainly something perplexing in the observations of this evening (May 10), when Respighi attributed to it, as we must suppose Mädler to have done, a diameter of 4″ and a great depth, while Schmidt described it as a bright hill casting a shadow, half as large as the nearest crater N.W. (*Linné* A), and Ingall called it a mere "aspect" or "idea" of a small crater in the white spot. But these discrepancies, however they may be explained (and we may remark that there is no other record of its having been seen of these larger dimensions), do not affect the difficulty attaching to the published account of Baron Von Mädler's opinion. It is obviously very desirable that a continuous watch should be kept upon this object, which has been pushed forward into a position of so much interest: but it should be remembered that no satisfactory result can be expected from telescopes incompetent to show very minute details with precision. The black shadow in the interior of the little pit has been estimated by Schmidt on different occasions at 0″·45, 0″·27, 0″·24, and even

0″·18, and by Buckingham at 0″·24. Huggins, indeed, has given a more visible amount, 1″·71; and the apparent breadth is no doubt different with different angles of illumination; but under any circumstances the possessors of second-class instruments need not be surprised if they miss it altogether.

On the same morning I had a fine view of the remarkable cavity (Humboldt would have called it explosion-crater) *Hyginus*, particularly described in "Intellectual Observer," No. 68. It was at this time nearly filled with a black shadow, crossed by two delicate white streaks, not parallel, as they were once seen by Beer and Mädler. They say of it that the great and well-known cleft passes through the crater so as to dislocate its rampart, and traverse the interior with elevated edges, of the visibility of which they cite a solitary instance, 1832, Sept. 12, when a power of 300 showed two fine but very brilliant lines of light, whose position indicated accurately the direction of the cleft; the crater-rampart, where the cleft encountered it, being interrupted on the N.E. and W. by a very narrow but perfectly black shadow. The aspect of this spot, as I saw it under beautiful though vexatiously unquiet definition, was different. The two bright lines now visible diverged from the point where the cleft enters the crater on the W., and crossed the interior in the form of the letter V. The one most to the S. was evidently in the direction of the cleft; and though I could not be absolutely confident as to its quite reaching the E. side, I believe such to have been the case; the junction of this line and the black streak marking the continuation of the cleft to the E. could not be quite made out, though I perceived that the dark line lay a little S. of the bright one. The outline of the N. end of *Hyginus* is bent out abruptly into a semi-circular bay, figured in "Intellectual Observer," *ut supra;* the result we may suppose of another less powerful explosion, which though given but imperfectly by Lohrmann, and entirely missed by Beer and Mädler, will be recognized by any careful observer: the second of the lines of light bore slanting across the crater to the E. headland of this bay, where it forms a junction with the larger circle of the crater. On the W. side of *Hyginus* it did not appear to me that the cleft was continuous as a black line from the bright streak across the exterior plain; on the contrary, immediately over the place where the two white streaks abutted together on the cliff of the crater lay a black spot, and above it a white space disjoining this spot—the commencement of the dark line,—from its continuation through the plain westward. A little steadiness, waited for in vain, would have enabled me to make this

out more perfectly; as it was, the appearance was that of an embankment carried across the crater, entering a tunnel at some depth below the topmost edge of the crater, and coming out a little further on in the form of a cutting. Or it looked much like a transverse hole made by an awl too near the end of a strip of deal, which has displaced its own breadth of the wood in the direction of the grain. I must, so far as I have hitherto seen, agree with Schröter and Lohrmann as to the absence round *Hyginus* of the "rampart" described and figured by Mädler; at least if it exists, it must be extremely flat and low.

I would take this opportunity of referring to the diagonal prism apparatus, contrived and beautifully executed by Mr. Browning, to enable the possessors of silvered glass reflectors, where a silvered "flat" or totally-reflecting prism is employed, to observe solar phenomena. Whether these can be successfully studied with the ordinary Newtonian, I am unable to say, having given but insufficient attention to the point; if, however, it should be found that the action of a powerful sun sets up too much tube-current, still the adoption of a skeleton-tube would obviate this difficulty, and there can be little doubt that with this precaution, and the insertion of a diagonal prism in place of the usual totally-reflecting prism or "flat," a most suitable apparatus could be formed for solar observation. Those who wish to pursue this subject exclusively would find an unsilvered large mirror peculiarly efficient. In my own case, the instrument being permanently fitted with two silvered mirrors for lunar or sidereal purposes, the brass adapter carrying the diagonal prism is inserted in the place of the eye-piece, and the latter receives the rays reflected from the prism in a fresh direction, perpendicular to that from the flat to the prism. The limited range of the sliding motion of my flat requires the lengthening of the focus by a Barlow lens, but, this being introduced between the prism and the flat, the arrangement is rendered complete. This apparatus, as was suggested to me by Mr. Browning, is of much value for studying the markings of the Full Moon; hitherto a comparatively neglected line of research. I find the image thus given extremely soft and beautiful; and even Jupiter showed his belts with very fair distinctness, though the enfeebled light reduced the diameters of his satellites in a striking degree. One remarkable feature, however, was the altered character of the definition. A sharp but fluttering image, such as I am but too familiar with, is thus tranquillized in a singular manner: still, definition as a whole is not materially a gainer by it, a slight want of

precision, or what might be termed feebleness, taking the place of a troublous agitation. The object is no longer seen as through clear, but rippling water, but as through a mist. This trifling diminution in sharpness might have been ascribed to the repeated reflection at plane surfaces, the difficulty of making these true being generally acknowledged; but such is the excellency of Mr. Browning's work that I believe it to be almost entirely due to the great reduction of light, masking in some way the effect of an undulating atmosphere.

To persons of sensitive vision the aspect of the Moon with a large aperture is absolutely distressing, and it is probably far from beneficial even to stronger eyes. In order to avoid this inconvenience, it is not the most advisable, though it may be the readiest, way, to reduce the effective aperture by a diaphragm. In the case of mirrors so accurately parabolized as those of Mr. With, as well as of all well-corrected object-glasses, the sharpness of definition is in proportion to the breadth of aperture; and this great advantage ought to be carefully preserved. It was by contraction of aperture that Hevel in ancient days enlarged the apparent, or *spurious* discs of stars, till he thought he had accomplished a great feat in making his old refractor produce so fine an image—that is, as we now know, one so very wide of the truth. The modern optician's object is to reverse that process, and to enlarge his aperture to the utmost, consistent with accuracy of curvature; and he is never so well satisfied as when his instrument brings out the minutest spurious disc that the laws of optical interference allow. And with that minuter stellar disc, he naturally gains the greater precision in lunar or planetary definition. To contract, therefore, the aperture of a well-corrected instrument is to reduce it to the level of one of inferior defining power. There are several means of avoiding this, and keeping the full breadth of the rays while we diminish their intensity. One is by a diaphragm covering the whole aperture, but pierced with many small openings; this, however, cannot be recommended, as it greatly multiplies the interference. A far more unexceptionable one is the Browning diagonal prism just mentioned, or we may resort to a Dawes' eyepiece, in which the field is contracted by a succession of diaphragms to any required dimensions; or for ordinary purposes, and to save expense, a single small diaphragm inserted permanently into the eye-piece, reducing the ordinary field to 2′ or 3′, will answer very well: and any amateur can construct it with a bit of zinc or card. In this way the cone of light from the mirror or object-glass is preserved entire, but we keep out of the

eye all but what we want to employ, and so retain the whole sharpness, while we avoid the distressing flood of unnecessary radiance. The same advantage may also be attained by a suitable employment of concave lenses, in consequence of the contraction of their field. Any of these plans will answer for separate details, but where a larger surface is to be viewed at once, and the relative brightness of different parts of it is to be compared, the latter would be found disadvantageous. In the paper already referred to, Baron Von Mädler has recommended to the especial notice of observers, as "a hitherto little considered subject, and one formerly very erroneously interpreted," the luminous streaks of the Full Moon, which deserve a special investigation both as regards their nature, and the possibility of change; of which some obscure intimations might be adduced: and for this interesting inquiry the diagonal apparatus presents the greatest facility, and may be very confidently recommended.

A NEW MAGNETO-ELECTRIC MACHINE.

Many ingenious contrivances have been used for the production of electric currents from permanent magnets. The general principle of the construction and action of such apparatus is as follows :—

A bar of soft iron is made to revolve with great rapidity in front of, or between, the poles of a permanent magnet or magnets. On the bar of iron, or revolving armature, is wound a quantity of fine copper wire, insulated with a covering of silk. Motion is communicated to the armature by some arrangement of multiplying wheels. Every time the direction of the armature is changed relatively to the poles of the permanent magnet an induced electric current is generated in the coil of insulated wire surrounding

it, the current being reversed in its direction twice in the course of each single revolution of the armature. The reason of this reversal will be understood when the cause of the production of the electric current is more fully explained.

Faraday demonstrated the production of an induced electric current by the action of a permanent magnet by the following beautifully simple experiment. A coil of insulated copper ribbon, about forty feet long, was wound in a single flat coil, like a chronometer spring, round a soft iron rod. The end of the ribbon was drawn out of the centre of the coil, and soldered to a small plate of copper, stouter than the ribbon. One surface of this plate was amalgamated with mercury. The outer end of the ribbon was pointed and bent in the form of a letter S, so as to act as a spring, and rest lightly on the amalgamated plate. The iron rod on which the coil was wound was placed on the poles of a powerful permanent magnet, supported in a vertical position. Thus placed, the rod became itself a magnet by induction, and generated an induced current in the coil of insulated copper ribbon wound upon it. Induced currents being instantaneous, are only present at the moment of making and breaking contact between the bar and the magnet. When the contact was broken with a sudden jerk, the spring end of the ribbon flew up from off the amalgamated copper plate on which it rested, and deflagrated a portion of the mercury, producing a small bright spark. On reversing the ends of the bar relatively, it becomes an induced magnet with its poles reversed, and the current induced in the ribbon will run in the contrary direction. If instead of fifty feet of copper ribbon, we wind fifty yards of fine insulated wire upon the iron rod, and attach the rod by its centre to an axis at right angles to itself, as well as to the poles of the permanent magnet, and bringing the two opposite ends of the fine wire into contact, by means of springs with two separate pieces of metal, upon touching both pieces of metal, while the axis is rotating, a strong electric current will be felt.

Machines of this kind, as usually made, are only powerful enough to produce physiological effects. Those which have been made powerful enough to exhibit effects similar to voltaic batteries or plate-glass electrical machines, have been so cumbersome and expensive as to preclude their coming into general use.

Mr. Browning, of the Minories, has just introduced a magneto machine of novel form and arrangement, in which the disadvantages of the old machines have been completely removed.

In the engraving, A A are two permanent magnets, of a similar

form, whose poles at the lower part nearly approach, and actually face each other. B is an armature of soft iron, round which a quantity of insulated copper wire is wound lengthwise. The armature is made to revolve with great rapidity by the following ingenious arrangement. The handle in front of the instrument communicates motion to the cog wheels at C, which are a modification of Watt's celebrated sun-and-planet-motion. The wheel D moves with the cog wheels, and being attached to a hollow arbor through which the spindle passes, to which the handle is attached, it makes six revolutions for one turn of the handle. The rim of the wheel D gives a multiplied motion to the armature B, which is thus caused to revolve nearly thirty times for every time the handle makes one revolution.

The ends of the insulated wire on the armature are connected with the two brass balls in which the wires marked E are fixed. A commutator, which cannot be seen in the engraving because it is behind B, controls the connection, in such a manner, that all the positive currents are sent to one ball, and all the negative to the other.

Two armatures are supplied with each machine, one containing a few yards of insulated wire of large size. This is known as the quantity armature. The other armature contains a great length of exceedingly fine insulated wire. This is the intensity-armature. The quantity-armature produces effects similar to those produced by a voltaic battery; the intensity-armature such results as are obtained by means of an electrical machine.

With the quantity-armature the following effects can be produced:—Half an inch of platinum wire placed between the poles at E, can be made white hot in a few seconds. An induction-coil may be made to give off bright sparks, or illuminate small induction-tubes. Bells may be rung, or telegraphs worked, even at a distance of many miles. Water or chemical salts may be decomposed.

With the intensity-armature, Abel's fuzes may be fired, and most powerful physiological effects may be produced. The power of the shock-current may, however, be modified to any extent at the will of the operator, so that it may be made quite unbearable, or scarcely perceptible, as desired.

The decomposition of metallic salts under the microscope is a singularly beautiful experiment. It is only necessary to place a small quantity of a metallic salt, such as sulphate of copper, nitrate of silver, or acetate of lead or zinc, in solution, in a hollow glass

cell on the stage of the microscope; then bring the ends of the wires from the machine, and dip them into the liquid. Upon turning the handle of the machine, the salt will be decomposed, and the metal will be deposited in the form of crystals upon the end of the wire forming the negative pole.

If the current from the quantity-armature be sent through a short coil of stout insulated wire, wound round a rod of soft iron, bent into the shape of a horseshoe, the iron becomes a magnet, and will support a weight attached to its feeder. Here we see the permanent magnetism of the magnets make the revolving armature an induced magnet. The interruptions in the magnetism of the armature, caused by its revolution, induce a current of electricity in the wire wound upon it; and the passage of this electric current through the coil of wire on the soft iron horseshoe converts the iron bar into an induced magnet.

The machine we have described moves with very little friction, is very compact and portable, and is comparatively inexpensive, being less than one-third the price of the old machines of equal power. With the intensity-armature a most powerful and intense current is produced. The current is completely under control, and, as we have said, can be modified at pleasure, so as to be applicable for medical use. By an ingenious arrangement of the commutator, the current is made to flow continuously in one direction. Dr. Richardson, F.R.S., so well known for his most valuable method of using ether-spray for the purpose of producing insensibility to pain, instead of administering chloroform to patients about to undergo surgical operations, states that he has used this magneto machine with great success.

For any purpose, the effects of a moderately powerful voltaic battery may be produced, without the trouble and inconvenience attending the use of batteries. The instrument is elegant in appearance, and always ready for instant use.

WOMANKIND:

IN ALL AGES OF WESTERN EUROPE.

BY THOMAS WRIGHT, F.S.A.

(With a Coloured Plate.)

CHAPTER IX.

WOMANKIND IN THE FEUDAL CASTLE (*continued*)—WOMAN'S AMUSEMENTS—THE GARDENS OF THE CASTLE—PET ANIMALS.

It was in the earlier part of the day that most work appears to have been done by the ladies of the feudal household. Our forefathers began their day with sunrise, and considered that it ended about eight or nine o'clock in the evening, when they usually retired to bed. They rose very early, and, after performing their religious duties, they, to use their French phrase, *déjeunaient*, which our English translated literally by *they broke their fast*, but *breakfast* appears not to have been looked upon in the light of a meal. The two meals of the day were *dinner*, about the middle of our forenoon, and *supper*, which was taken at about four or five o'clock in the afternoon. In the later part of the feudal period, when people of fashion began to prolong the day into the night, they had a second and later supper, probably about the older hour of bed-time, which they called the *arrière souper*, and which was known in England as the *rere-supper*.

The part of the day before dinner appears to have been employed by the women of the castle chiefly in work. At the dinner-table, in the great hall, the whole household assembled. The meal was closed by the washing of hands, and then everyone was at liberty to remain in the hall, or to seek amusements through the chambers or in the other parts of the castle. The knights and ladies of more matronly bearing appear to have remained for some time in the hall, or to have sometimes adjourned into a less public apartment, where wine and ale were served round to the former, while minstrels chanted to them, accompanied by the harp, legends from their own family history, or scenes from the romances, or other subjects of interest, or told and even acted tales, with a variety of performances which, like the tales, were commonly of a very licentious description, and speak little for the delicacy of feudal society. One of the amusements of these old heroes, which seems to have prevailed chiefly in the earlier ages of feudalism, was especially characteristic, and belonged to those great northern races from whom we claim our own descent. When the primeval warriors sat round their hall drinking their ale or mead, one of their great amusements

was uttering extravagant boasts of the feats which each had done, or would do, and passing satirical jokes upon others. This proceeding was called *gabbing*, and the boasts and jests were called *gabs*. The word is preserved in our Anglo-Saxon under the forms—*gabban*, to joke or jeer; *gabbung*, joking; *gabbere*, a joker;—and it took its place in the French language of feudalism as *gaber*, to joke or banter; and *gab*, *gabois*, or *gaberie*, a joke or pleasantry. It was considered to be a great accomplishment in a gentleman to excel at a *gab*. In the Romances of the Round Table, Sir Keu was celebrated as the most accomplished gabber in King Arthur's court, and was the terror of all who could not bear a sarcastic joke with equanimity. There is preserved a curious little poem in Anglo-Norman, of the twelfth century, which relates how Charlemagne and his douze pairs went on a pilgrimage to Jerusalem, taking in their way Constantinople, where they were courteously received by the Emperor, or, as he is here called, King, Hugo. At night they were placed in a good chamber with beds enough for them all, and, plentifully supplied with wine, they lay down, drank their wine, and began to gab, Charlemagne claiming the right to say his gab first—

E dist Carlemaines, "Ben dei avant gabber."

The emperor's boast was, that if the strongest of Hugo's knights, doubly cased in armour, were placed on his steed before him, he would strike him on the helmet with his good sword with such force, that the blade would pass through the whole length of his body, armour and all, and through the horse, and afterwards into the ground, up to the handle. The *gabs* of the other paladins were still more extraordinary; Oliver made boasts in regard to the emperor's daughter which I will not here repeat. But King Hugo had been suspicious of his guests, and placed a spy in their chamber, who repeated to him all they had said, and the results of this form the subject of the poem. It may be remarked, that in the latter ages of the word *gab*, the ladies, who had not been admitted into the gabbing of the primitive period, were as skilful in its use as the other sex, and perhaps more so. Many of the domestic games of the feudal period were formed chiefly for the purpose of this spirit of gabbing, though the gabbing took rather a different form. A poet of the thirteenth century tells us a story of one of these games, which was called *Le roi qui ne ment pas*, the king who does not lie, in which, as it might happen, a lady or a gentleman was placed on the playful throne, and each of the others had the right of putting a question and receiving a truthful reply. The questions and answers were generally satirical—veritable gabs—and, in the case

to which I allude, are now not capable of being repeated. This was the character of most of the popular games of the feudal period. This same spirit of gabbing continued beyond the middle ages. In the fourteenth century we find it in games of chance, in which sarcastic characters were drawn upon rolls of vellum or paper, with marks attached to each, and you drew by chance, and took what you got, and were no doubt laughed at for it. This roll was called a *Rageman Roll*,—Rageman perhaps meaning the devil, who was supposed to direct the chances of the game, which were of a rather disreputable character. The spirit of this game continued to the age of Elizabeth and James I., when it appeared under the shape of roundels, discs of wood for serving fruit or confectionaries round to the festive party, which you turned up after having eaten the fruit, etc., and found on the under surface a satirical motto, which was supposed to apply to yourself. It was especially a lady's game. I have printed two of the Rageman's Rolls, one in French, the other in English, in my "Anecdota Literaria."

After the washing of the hands after dinner, a drink was usually served round, and then, as stated before, the younger portion of the family of the castle rose from the table, and proceeded in groups to amuse themselves in different ways. Some went in couples, apart, making love. Many formed parties, who conversed, told stories, and sang songs. Minstrels, and jougleurs, and mountebanks, found a welcome in the castle, and always received their reward. Others spread through the chambers, and in the gardens, and out into the meadows, and joined in dances, and in games of various descriptions. When Jean of Dammartin was regularly retained in the household of the Earl of Oxford, and in the service of the fair Blonde, the poet who composed the history tells us how—

Après manger lavent leurs mains,	After dinner they wash their hands,
Puis s'en vont juer, qui ains ains,	Then go to play, in emulation of one another,
Ou en forès ou en rivères,	Either in the woods or on the banks of rivers,
Ou en deduis d'autres manières.	Or in pastimes of other kinds.
Jehans au quel que il veut va;	Jean goes to whichever he pleases;
Et quant il revint souvent va	And when he returns, he often goes
Jouer as chambres la contesse,	To play in the chambers of the countess,
O les dames, qui en destrèce	With the ladies, who in confinement
Le tienent d'aprendre François.	Hold him to learn them French.
* * *	* * *
De jus de cambres seut assés,	Of chamber games he knew plenty,
D'eschés, de tables, et de dés,	Of chess, of tables, and of dice,
Dont il sa damoisele esbat;	With which he amuses his damoiselle;
Souvent li dist eschek et mat,	He often says to her check and mate,
De maint jeu à juer l'aprist.	He instructs her in many a game.

Roman de Blonde, l. 387.

In the Roman de la Violette, the young gentlemen and ladies are described as, after dinner, spreading similarly through the castle, attended by minstrels with music. The ladies of the feudal ages were passionately fond of dancing. They danced in the chambers, and in the gardens, and they even wandered into the fields to dance. The favourite dance was the *carole,* in which those who joined in it danced in a ring and accompanied their movement with singing, and which was so universally used, that the common word for, to dance, was *caroler*—to carol. In the romances of the Round Table, one of the heroines, the lady of the Terre-Lointaine, lost in admiration at the fair dancing in the meadow of the Forêt

A DANCE AT COURT.

Périlleuse, says to the enchanter, Guinebaut, "Think you not, fair sir, that one would be very happy to follow these fair caroles all the days of one's life?" and, to please the lady, Guinebaut placed the carole under a charm, which prolonged it to a very indefinite period. The accompanying cut is taken from one of the illustrations in the illuminated manuscript of the Roman de la Violette, and represents a carol at one of the grand feasts of the royal court of Louis-le-Gros. Every reader of the "Roman de la Rose" will remember the description of the gay carole led by Liesce (*Joy*) in the garden of Deduit.

The ladies of the feudal ages were partial, also, to games

of skill, especially to tables and chess, the former of which was played with dice, and appears to have resembled our back-gammon. The game of tables appears to have been of great antiquity among our race, but before the ages of feudalism it seems to have been confined chiefly to the male sex; in the feudal castle the ladies embraced it eagerly, and in the illuminated manuscripts, when we find a party engaged in this game, it is almost invariably a lady and a gentleman.

A GAME AT DAMES.

The cut given in our margin, taken from the interesting and well-known manuscript of the beginning of the fourteenth century, known as Queen Mary's Psalter (Br. Mus. MS. Reg. 2 B. VII.), represents another game of this kind, called the game of *dames*, which is still known in France by the same name; though, in England, this name was changed before the sixteenth century into that of *draughts*, which is said to have been given to it because, in playing, the pieces are *drawn* from one square to another. The game of dames, as being much less exciting than tables, was therefore far less popular, and is not so frequently mentioned in the old writers.

A PARTY AT CHESS.

prince of games was always that of chess. Among

the first things included in a liberal education for either sex was skill in playing at tables and chess, and a party at chess is not unfrequently represented in the illuminations of manuscripts. It usually consists of a gentleman and a lady playing together. Walter Mapes, in his book, "De Nugis Curialium," tells a story of a Breton prince, who was accustomed to play at chess with his lady; and, in the romances of the Round Table, the enchanter, Guinebaut, gives to a fair lady a chess-board and men, made half of gold and half of ivory, which possessed the quality, that, when a gentleman and lady played at it, the lady always gained the victory. The accompanying cut, taken from a finely-illuminated manuscript of the romance of the "Quatre Fils d'Aymon," in the Bibliothèque de l'Arsenal, at Paris, executed in the fifteenth century, represents a nobleman and one of the great ladies of his household playing at chess together, apparently in a sort of alcove adjoining the garden, which latter forms the background of the picture.

Other amusements of the squiers and damoiselles of the castle consisted of what we should now call romping games, allied with our hunt-the-slipper, hide-and-seek, etc., and these appear to have been rather numerous. They were generally of such a character as to admit of both sexes displaying their skill in the accomplishment of gabbing, already alluded to, and we have no want of evidence that this was often carried far beyond what would be allowed by modern delicacy. One of them, entitled *Le roy qui ne ment pas*, has already been described. The names of others of these games are sometimes mentioned, but, with some exceptions, we are not well acquainted with their character. In a story in the Ménagier de Paris, compiled in 1393, the ladies, visited unexpectedly after supper, were found, some playing at *bric*, others at *qui féry?* (who struck?) others at *pince-merille*. The first of these games, which was played with a small stick, or wand, is mentioned by Rutebeuf in the thirteenth century. "*Qui féry?*" appears to have been the game which was called in English hot-cockles. The exact character of the game of *pince-merille* appears not to be known; but *tiers* is understood to have been a sort of blind-man's-buff. We might add other names to these, and, in fact, the games of this description appear to have been very numerous. The reader of Rabelais will remember the immense list of those which were taught to the youthful Gargantua.

The ladies and damoiselles of the castle are everywhere described as exceedingly fond of wandering in their gardens, and through

them into the meadows, and listening with great pleasure to the song of the birds. They had a fashion, which prevailed very generally at the season of the year, of dressing their heads with garlands and chaplets of flowers. When Jean of Dammartin sought Blonde of Oxford one day, and looked from the chamber, he saw her in a meadow, where she was making a chaplet—

> Adonc de la chambre s'avance,
> De là la vit en j. prael
> U ele faisoit un capiel.
> *Blonde of Oxford*, l. 850.

In a poem in praise of the fair sex, published by M. Jubinal, from a manuscript of the thirteenth century, we are told that she makes chaplets of flowers for those who love—

> Si fet fere chapiaus de flors
> A cels qui aiment par amors.
> *Jubinal, Jougleurs et Trouvères*, p. 85.

In another piece, published by the same editor, the lady is crowned with a chaplet of flowers of very great beauty—

> Une chapiaux de fleurs acorone
> La dame de moult grant biauté.
> *Lettres à M. de Salvandy*, p. 160.

These chaplets of flowers were not worn only by the gentler sex, for we are told in the romance of Lancelot, that "there was no day in which Lancelot, whether winter or summer, had not in the

DAMOISELLES MAKING GARLANDS.

morning a chaplet of fresh roses on his head, except only on Fridays, and on the vigils of the high feasts, and as long as Lent lasted." In the "Roman de la Rose," Deduit, or Pleasure, the lord of the garden, has a garland of roses on his head, which his lady-love, Liesce, Joy, had made for him :—

> Par druerie et par solas
> Li ot s'amie fet chapel
> De roses, qui moult li siet bel;

and so has Love. It appears to have been customary at this time for the damsel to make a chaplet of roses to place on the head of her lover.

The preceding cut is also taken from the manuscript, known as Queen Mary's Psalter (MS. Reg. 2 B. VII.), of the beginning of the fourteenth century, and represents a party of damoiselles, apparently in the open meadows, gathering flowers, and making their garlands.

It will be remembered how Emelie, in Chaucer's Knight's Tale, rises at daybreak to descend into the garden, and make herself a garland—

> Iclothed was sche fressh for to devyse.
> Hire yolwe (*yellow*) heer was browdid (*platted*) in a tresse
> Byhynde hire bak, a yerde long, I gesse.
> And in the gardyn, at the sonne upriste (*at sunrise*),
> Sche walketh up and doun wheeras hire liste;
> Sche gadereth floures, partye whyte and reede,
> To make a certeyn gerland for hire heede,
> And as an aungel hevenly sche song.

In the Lay of Aristotle, the mistress of king Alexander is described as descending early in the morning to walk in the garden, and make herself a chaplet of flowers. Quotations illustrative of this custom might be multiplied almost without end. Our next cut is

THE LADY AND HER DAMOISELLES IN THE GARDEN.

of rather a later date: it is taken from the manuscript service book of the fifteenth century, known as the "Heures" of Anne of Brittany, now in the Bibliothèque Imperiale in Paris. The lady of the castle is here making the garland, while her damoiselles are gathering the flowers.

We can understand the love of the ladies of the castle, and of the other sex also, for the pleasures of the gardens and of the fields, after being confined in the close and dull rooms of the feudal building. This feeling appears, indeed, to have been shared by both sexes, and hence we find not unfrequently the lords of the castle resorting to the garden to play at tables or at chess, or even to hold meetings of a more serious character. All, at times, sought their happiness in its charms. The knight of the Tour-Landry opens his book by telling us how, in the year 1371, at the approach of the month of May, sad and full of thought, he went into his garden, and seated himself in the shade, and how he listened to the singing of the birds until his heart became lightened, and his joy returned.

The garden was perfectly private, and with this object it was inclosed by walls. In Chaucer's Tale, the knight January

> —Had a gardyn walled al with stoon,
> So fair a gardyn wot (*know*) I no wher noon.

And Chaucer dwells warmly on—

> The beauté of the gardyn, and the welle (*fountain*)
> That stood under a laurer alway green.

A fountain was considered a necessary part of the knightly garden. In the description of the garden in the "Lais de l'Oiselet," we are told—

Et enmi ot une fontaine,	And in the middle there was a fountain,
Dont l'iaree estoit et clere et saine;	The water of which was both transparent and wholesome;
Et surdoit de si grant randon,	And issued with so great force,
Com s'ele boulist de randon;	As though it boiled violently;
S'iert ele plus froide que marbres.	And it was colder than marble.

This fountain was shaded by beautiful trees, so thickly leaved that the sun's rays could not penetrate to it. In the garden where the two maidens went to amuse themselves in the fabliau of Hueline and Aiglantine, the fountain was under a pine. The garden is generally described as being extensive. It appears to have been situated usually outside the walls of the castle, or castellated mansion, but we have few early descriptions to enable us to fix its exact position, especially in the large castles, though it was evidently easy of access from the chambers of the ladies, and it usually communicated with the fields. From the "History of Fulk fitz Warine" (p. 42), we learn that in the great feudal fortress of Ludlow, in the twelfth century, the gardens lay in the fields under the rock on which the castle was built, and they probably extended to the bank of the river Teme. Their position will be well understood by any one who has visited Ludlow. We learn from other sources

that people always chose for the site of the garden, when they could, the bank of a river, and a castle was, indeed, usually built where a river flowed near at hand.

Probably some of those little postern-gates which still remain in the walls of our ruined castles, served the ladies of the household for private access to the gardens. There are more than one in the line of walls in Ludlow castle facing the gardens, as just described. It is certain that the apartments of the ladies had easy and private communication with the garden. In the story of the Chastelaine de Vergi, the lady of the castle appointed the knight, her lover, to conceal himself in a corner in the garden until he saw a little dog pass through, and then she would admit him into her chamber. In one of the episodes of the romances of the Round Table, the second Genevieve, after she is undressed, is conducted by her maid into the garden before being put to bed. This incident belongs either to the twelfth or to the thirteenth century.

A very famous description of a garden in the mediæval literature was that in the "Roman de la Rose," the hero of which, L'Amant, the Lover, in his wandering, comes upon an extensive garden, surrounded by a lofty wall. It is the garden of Deduit, Pleasure. L'Amant follows the wall round, and at length comes to a small entrance-gate, at which he knocks, and, after much importunity, obtains admission from dame Oyseuse, lady Idleness, a fair and noble maiden, who held the key of the gate. Eagerly the lover entered the garden, and thought he had found his way into Paradise, so beautiful was the scene, and so lovely and varied the song of the birds which abounded in it. Proceeding in search of Deduit, the lord of it, he found him with a fair party of companions indulging in all the amusements which a beautiful garden usually afforded. They were engaged in dancing a carole, which a very fair lady named Léesce, Joy, led with her song. Here the fair dame Courtoisie invited him to join in the dance. Then L'Amant went to examine the garden, and tells how it was filled with trees and flowers, and how he came to a beautiful fountain, under a magnificent pine, and enclosed in marble. It was the Fountain of Love. In the noble illuminated manuscript of the "Roman de la Rose" in the British Museum (MS. Harl. No. 4425), the illuminator has given a pictorial representation of this scene in the garden, which we have copied as far as could be done in our Coloured Plate, which will be given with our next chapter, in the number of THE STUDENT for February. It would be impossible to reproduce the minute delicacy of the original, nor have we attempted to give *all* the leaves, flowers, and birds which are introduced in it. A party are seen singing and

playing on the vieille, or fiddle. The lower part of the picture, which represented the garden wall and gate, and L'Amant obtaining admission, has been here omitted.

Chaucer, who appears to have had a great sympathy for the pleasures of the garden, dwells upon them often in his poems. In the "Frankeleyne's Tale," the friends of the lady Dorigen, seeking to rouse her from her melancholy, take her "by riveres and by welles" (*fountains*), and to other pleasant localities, where they dance, and play at chess and tables—

> So on a day, right in the morwe tide,
> Unto a gardeyn that was ther beside,
> In which that they had made her ordinance
> Of vitaile, and of other purveance,
> They gon and plaie heer al the longe day.
> And this was on the sixte morwe of May,
> Which May had painted with his softe schoures
> This gardeyn ful of leves and of floures;
> And craft of mannes hand so curiously
> Arrayed had this gardeyn of suche pris,
> As if it were the verray paradis.

MAUGIS WITH THE FAIR ORIANDE IN THE GARDEN.

The games and amusements of the garden are frequently alluded

to in the mediæval writers. The curious story of the Emperor Constant, published in the "Nouvelles Françoises en Prose du XIII^e. Siècle," records how "the emperor's fair daughter, after she had dined, went into the garden, with four of her maidens, and began to chace one another, as maidens play together sometimes."

The garden was also a common scene of love intrigues, and often plays that part in the mediæval romances and histories. It was in the garden that the fair dame of Fayel met the Châtelain de Coucy, and granted him her love. In the romance of "Maulgis et la Belle Oriande," the hero and heroine are introduced making love in the garden. "They met in a garden to make merry and amuse themselves after they had dined, and it was the time for taking a little repose. It was in the month of May, the season when the birds sing, and when all true lovers are thinking of their love." The scene is represented in the accompanying cut, taken from an illuminated manuscript of the romance, of the fifteenth century, preserved in the Bibliothèque de l'Arsenal in Paris. The two lovers are sitting on a grassy bank, supported by a low wall. The garden itself is square, enclosed by walls and towers, with two entrances—one from the castle; the other, through a gate between two towers, from the fields. A pear-tree, in the garden of her father, was the place of meeting of Blonde of Oxford with her lover Jean of Dammartin, and it was thence that he finally carried her away. Similarly, among the songs of the "Romancero François," the fair Béatris appoints her lover, Count Hugo, to meet her in the garden of her father's castle, and it is from thence she elopes with him. And I might produce many other similar examples.

Our next cut is taken from a manuscript of the fifteenth century in the British Museum (MS., Reg. 15, D. III., fol. 298). It also represents a lady and a gentleman, dressed in the full of the fashion, meeting in a garden.

But one of the most favourite pleasures of the garden appears to have been listening to the singing of the birds. One of the early lays relates how King Arthur, with his queen, Geneviève, and a party of his courtiers, one day rode out of Cardoil to take their disport in the forest; and, when he entered it,—

Lou chant des oisiax escouta,	He listened to the song of the birds,
Qui moult chantoient doucement.	Which sang very sweetly.
Tant i entendi longuement,	He listened to it so long,
Por ce qu'il en oi plenté,	Because he heard much of it,
Que il entra en un pensé	That he fell into a musing
D'une aventure qu'il savoit,	On an adventure which he knew,
Qui avenue li estoit.	Which had happened to him.

Méon, Nouveau Recueil, i. 128.

The writer of the "Roman de la Rose" has given a long enumeration of the variety of birds which filled the garden of Deduit with their songs, and appears to have been chiefly anxious to prevent any one supposing that any bird of which the name was

A GARDEN SCENE.

known was absent. There might be seen, he assures us, and heard, nightingales, jays, starlings, wrens, turtle-doves, goldfinches, swallows, larks, titmouses, "calendres," blackbirds, "mauvis," and he even places parrots among them. We can hardly suppose that parrots were seen flying wild and *singing* in a mediæval garden. But a writer of a much more serious character than Guillaume de Lorris has gone still further in the introduction of strange birds into the mediæval grove. John de Garlande, a scholar of the thirteenth century, says that the fowler (*auceps*) went into his grove to catch, among other birds, a phœnix.

The ladies of the castle, and of the aristocratic class generally, were much attached to pet animals, and especially to birds. In the engravings we have already given, we have seen frequent examples of a small pet dog, or, as it was usually called by the diminutive of affection, *chiennez*, which seem to have been the ordinary companion of dame or damoiselle. The cat appears never to have been taken as a pet, except among old women, who were reputed as witches. A present of a tame bird appears always to have been considered acceptable to a lady. In the "Roman de la Violette," while Euriaus is lamenting over her griefs, a lad brings her a tame lark :—

Atant une variés li aporte	At that moment a valet brings her
Une aloie qu'il avoit prise,	A lark which he had caught,
Et l'avoit à chanter aprise.	And had taught to sing.
Euriaut à donné l'aloe,	To Euriana he has given the lark,
Et de chanter forment li loe.	And highly praises its singing.
La damoisiele prist l'oisiel,	The damoiselle took the bird,
Qu'ele ot rechut del damoisiel	Which she had received from the damoisel,
En son devant le prist à paistre.	And placed it in her lap to feed.
Rom. de la V., l. 3898.	

This bird was sufficiently tame not to be confined in a cage, for subsequently it flew away, carrying with it a jewel which became the cause of further grief. We see, however, in illuminated manuscripts, that birds in cages were far from uncommon, and in a picture given in a former chapter we have had, in a lady's chamber, a cage with a couple of birds in it. The accompanying cut, taken from a manuscript of the fourteenth century in the library at Paris, gives another example. Hawks and falcons were sometimes made pets, but the favourite bird for the cage was the pie, or magpie, the cunning of which and its skill at learning to talk have made it the hero of many mediæval stories. One of these is told by the knight of La Tour-Landry. There was a fair lady who had a pie in a cage which talked of everything it saw, and the lord of the household happened to have a fine eel, which he kept in his pond with great care for a feast which he intended to give to some of his friends. During his absence, the lady was seized with a longing for the eel, and it was agreed between her and her "ménagière" that they should eat the eel, and tell their lord that the otter

BIRDS IN A CAGE.

had stolen it; so when the lord returned, and inquired for his eel, he would have been deceived, but the pie never ceased crying out, "My lord, my lady has eaten the eel!" In their anger, the lady and her accomplice plucked all the feathers from the pie's head. And the poor pie was greatly mortified, and from that time, whenever a bald man approached, he shouted out in compassion, "Ah! you have been telling about the eel!" A jay was also a common cage-bird on account of the same capacity of learning to talk. A curious English political poem of the reign of Edward II., printed by the Percy Society, rather cleverly compares an ignorant priest to a jay in a cage—

> Certes also hyt fareth
> By a prest that is lewed (*ignorant*)
> As by a jay in a cage,
> That hymself hath beshrewed; (*cursed*)
> Gode Englysh he speketh,
> But he not (*knows not*) never what.
> No more wot (*knows*) a lewed prest
> His gospel wat he rat (*which he reads*)
> By day.
> Than is a lewed prest
> No better than a jay.

The parrot, for a similar reason, was a great favourite, but it was a bird not easily obtained, and therefore of rarer occurrence.

In a former cut we have seen a tame squirrel in a cage, and singularly, though of so old a date as the fifteenth century, the cage is of the same revolving construction which has continued to the present day. The cut which we give here, taken from one of the compartments of the Tapestry of Nancy, executed also in the fifteenth century, represents a lady holding a tame squirrel attached by a cord. Tame squirrels are introduced more than once in old mediæval stories.

THE TAME SQUIRREL.

MOLLER'S DIATOM TYPE SLIDE.

We are indebted to Mr. Curteis (of Baker's) for calling our attention to and procuring a specimen of Möller's Diatom Type Slide, a marvellous specimen of skill, exceeding anything of the kind previously attempted in the arrangement of minute objects. When we say that Herr Möller has managed to arrange in a classified scientific series a large collection of diatoms on a single slide, and in such a compass, that a view of the whole can be obtained at once with a two-inch power, and that the separate diatoms, though of very various dimensions and thicknesses, are nearly all fit for the minutest examination, we shall afford some notion of the value of this remarkable slide.

The total number of diatoms is more than 450, and they are grouped in four series. With dark-ground illumination, and a low objective, the whole are brought simultaneously before the eye in a singularly beautiful way, and it is exceedingly interesting to contrast the varied forms presented by this remarkable family of silex-secreting plants. Each of the four series will be found composed of diatoms arranged in six lines, one under the other, like the pages of a book. Fine specimens of *Eupodiscus argus* mark the beginning and the end of each series, and the "Systematic Catalogue," issued with the slide, admits of easy reference. Thus, series 1, line 4, object 6, is *Fragillaria mutabilis;* series 4, line 1, object 6, is *Biddulphia aurita;* and so forth. The systematic arrangement is that of Herr Grunow, of Vienna, and in many cases valves are exhibited in different aspects.

The richness of this slide is astounding. Thus, there are nineteen objects belonging to the genus Epithemia, the same number of Eunotia, five of Merediones, thirteen of Synedra, etc., etc. In the catalogue they are grouped in families,—Epithemiæ, Meridionæ, Diatomeæ, Tabellariæ, Surirellæ, Nitzschiæ, Amphipleuræ, Coconeidæ, Achnantheæ, Cymbelleæ, Gomphonemæ, Naviculeæ, Isthmieæ, Biddulphiaceæ, Eupodisceæ, Melosireæ, and Chætocereæ. It is thus easy to compare the different families together, and note what characteristics their species bear in common, and how they differ from other groups.

We cannot imagine that any large number of slides, requiring such a remarkable combination of patience and skill, will be issued. Ours is numbered thirty, and we do not envy the preparer his laborious job. We used to think a good deal of a half a dozen or

a dozen diatoms elegantly arranged; but to persuade hundreds of these minute objects to stand in order, with military precision, was what we never expected to see.

Of course many will desire to possess this slide, simply on account of its rarity and beauty; but we hope its scientific value will also be appreciated, and we trust microscopists will not underrate the value of a systematic collection because they have it on a single piece of glass, instead of scattered through a cabinet full of drawers.

The objects are attached to the covering glass, which is very thin, so that it allows the use of the highest powers. We resolve, for example, both sets of lines or *Navicula rhamboides* with a one-twentieth objective.

LIFE IN THE DEPTHS.—DR. CARPENTER'S EXPEDITION.

Few discoveries more striking and interesting have been made in zoology than those which have made us acquainted, to some extent, at least, with the inhabitants of the sea-bed at great depths, and shown that, so far from the bed of the ocean being as barren as naturalists and physical geographers fancied, it is well peopled with appropriate organisms, wherever the temperature favours the development of life. Edward Forbes contended that life must cease at a depth of less than 600 fathoms. He placed his lowest deep coral zone at from 300 to 550 fathoms, and concluded that in it life was feebly exhibited, or altogether extinguished, and even Faraday threw discredit upon discoveries of living bodies at great depths, on the ground that the pressure would be so enormous that they could not exist.

When Dr. Wallich published the first part of his uncompleted work on the "Atlantic Sea-bed," in 1862, he adduced fresh and remarkable proofs that life, not only of the lowest kind, but of a more elevated character, could be found at 1260 fathoms, from whence he brought up star-fishes (ophiocoma), adherent to his line. Of course, it was easy for doubters to say that the creatures were floating in the water much nearer the surface, but those best acquainted with the nature of these animals accepted Dr. Wallich's explanation, and believed that they really came, as he supposed, from the deep sea-bed, and confirmed the theoretical conclusions he had previously expressed. The passage in which this remark-

able capture is described, runs as follows: "What mechanical ingenuity failed to achieve, hunger or curiosity accomplished; and thus, while the sounding apparatus only succeeded in bringing from a depth of 1260 fathoms a number of minute shell-covered creatures, so simply organized as to render them incapable of perceiving or escaping a danger, thirteen star-fishes, ranging in diameter from two to three inches, came up, convulsively embracing a portion of the sounding line, which had been paid out in excess of the already-ascertained depth, and rested for a sufficient period at the bottom to permit their attaching themselves to it. These star-fishes arrived at the surface in a living condition, and, what is more extraordinary, continued to move their long spine-covered rays for a quarter of an hour afterwards."

Sir John Ross published in 1819, an account of "sea worms," etc., which he brought up in Baffin's Bay, from depths at which no life was supposed to exist; and "thirty years after" (we quote from Dr. Wallich), "Sir James Ross reported having dredged up creatures from great depths in the Antarctic Seas." Both naturalists and physicists, were so much under the control of prejudice, and so little disposed to take in new ideas that contradicted old ones, that these discoveries were completely disregarded, together with other evidence of a similar description, until Dr. Wallich published his researches, and he did not meet with the treatment he deserved.

It was impossible to doubt the evidence of numerous soundings, in favour of the existence of low organisms at great depths; but it was still erroneously supposed by many scientific men, that nothing as high as an echinoderm, or a mollusk, could exist. Fortunately, the question is now completely settled by the dredgings of Sars and by those which Dr. Carpenter, accompanied by Professor Wyville Thomson, entered upon this last August; for although he did not succeed, owing to the state of the weather, in exploring extreme depths, he was brilliantly successful in water exceeding 600 fathoms.

On the 9th inst., Dr. Carpenter exhibited a remarkably interesting series of specimens to the Royal Microscopical Society, and delivered a lecture upon them. He had previously handed in a report to the Royal Society, and a full account of the discoveries made by himself and his colleague, will ultimately appear in the *Philosophical Transactions*, illustrated by beautiful drawings of the objects found.

The Admiralty, at the request of the Royal Society, placed the

"Lightning" at Dr. Carpenter's disposal for these instructive investigations, and it is to be hoped that the Government will now see the importance of undertaking a thorough exploration of the sea-bed in well-selected localities. Dr. Carpenter has fully confirmed Dr. Wallich's views that temperature, and not depth, determines the existence and abundance of deep-sea life. His dredgings and soundings were made between the north of Scotland and the Faroe Isles, and by sending down registering thermometers he was able to show the existence of a warm and a cold area, the one abounding and the other deficient in living forms. The coldest part of this area was in lat. 60° 7′, long. W. 5° 59′; when at a depth of 550 fathoms, the bottom current was not higher than 32°. Near this cold area the warmer area began again. At 300 fathoms deep, in lat. 59° 20′, long. 7° 5′, the bottom temperature was 49°; and in lat. 59° 5′, long. 7° 20′, at 530 fathoms it was 47° 3′. The surface temperature at the same time ranged from 50° to 52°.

It was remarkable that many of the foraminifera procured from the deep sea-bed were not dwarfed, as was formerly supposed must be the case by the pressure and other peculiar conditions; on the contrary, many specimens obtained in the warm area were of unusual size. In this warm area the Hyalonema was found growing with the long fibres rooted into the mud, like the specimens obtained by Dr. Percival Wright, and some remarkable siliceous sponges were also procured. One of them is a globular cup composed of layers of siliceous threads, interlaced so as to form a network of great beauty. It is also provided with long root spicules, and similar spicules projecting from the upper surface. Many other new sponges were obtained, which Professor Wyville Thomson will describe.

In previous soundings naturalists have been struck with the existence of a viscid mud abounding in minute life. Dr. Carpenter found this mud widely extended in the warm area north-west of the Shetlands. It abounds in the protoplasmic matter which Huxley has named Bathybium, in Coccoliths, Cocospheres, etc.

At 500 fathoms and more, not only was life abundant, but various, comprehending, in addition to the lower organisms, mollusks, crustacea, echinoderms, etc.; amongst them the Rhizocrinus of Sars, referable to a type supposed to be extinct.

In one sounding the sand was composed entirely of Globigerinæ, and as these creatures could not exist in multitudes without a considerable supply of food, we must suppose that the deep sea contains myriads of infusoria suitable for their nutrition.

Dr. Carpenter discovered some bodies composed of sand grains,

which when broken disclosed yellow spherule-like eggs, and some larger objects in sand spheres which he conjectures to be the reproductive bodies of lituolæ. He also obtained large single-chambered foraminifera, with shells composed of sand grains, and exhibiting stellate prolongations, in some triradiate, others quaternate, and in some the branches only in a rudimentary state. We have only attempted to give a general idea of these important researches; at a later period we hope to return to them, and lay before our readers more detailed accounts of their interesting results.

CORRESPONDENCE.

To the Editor of THE STUDENT.

SIR,—The always-welcome STUDENT has just arrived. You have given your astronomical readers a rich treat in this number. Mr. Browning's beautiful view of Saturn, with its accompanying paper, is worth very much to us, who have seldom a chance to look through a telescope of more than three inches diameter. Mr. Lynn's Notes for the Month are to me more than usually interesting; and Mr. Proctor's paper, coming, as it does, just after the November shower, is specially valuable. As I learn from these papers that a good display was not expected in England, I have thought it might be interesting to your readers to know how the meteors were seen at Toronto, where we have just had a splendid display.

The evening of the 13th was all that could be wished. The sky was beautifully clear; difficult double stars were easily divided, and the companion to the pole-star shone out with more than its usual brightness. I was at the telescope until about eleven P.M., observing the great nebula in Orion, and endeavouring to draw it; frequently looking out for meteors, but, with the exception of a few stray ones, none were visible. The earth had not yet entered the ring caused by the dispersion of Comet I., 1866. Between eleven and twelve P.M., however, meteors began to shoot up from the horizon, where Leo was just rising; and shortly after midnight, the shower had commenced in good earnest. Bright meteors shot out in every direction from a point within Leo, sometimes singly, at other times three or four at the same time, flying out like rockets in all directions, like the meridians on a globe spreading out from the poles. Some appeared like balls without trains; but more frequently they were followed by splendid trains. One, especially, which shot out a little above the radiating point, was followed by a very long train. It passed outward between Orion and the Bull, where the head disappeared; but the train of this meteor continued visible three or four minutes after the

head had burned itself up. The train, which at first was of a bright yellow, with a speck of fiery red here and there along its margin, became of a smoky white colour, and bent itself up into many contortions, like a serpent. (I wished for a spectroscope, but it was in vain. As far as I can learn, there is not one in Toronto.) In about fifty minutes I counted 212 meteors. The display continued till near morning. I enclose the statement of Professor Kingston, of our Meteorological Observatory, which will be more useful than my letter.

I am, truly yours,

TORONTO, *November* 18*th*, 1868. A. ELVINS.

"METEORS IN CANADA.

"Professor Kingston has favoured us with a statement of the number of meteors counted during the night of November 13-14, 1868, together with the corresponding numbers of November 13-14, 1867. The total number during Friday night will be found to have exceeded that of November 13-14, 1867. With the exception of about one per cent. the courses of the meteors were in directions from the constellation of Leo. Most of them were accompanied by trains; and, in several cases, the track remained visible from two to four minutes after the disappearance of the meteor. The majority of the meteors, particularly in the early part of the night, were extremely brilliant, and several exhibited a variety of colours. The apparent superiority of this recent display was owing to the remarkably clear state of the sky during the greater part of the night, and the absence of moonlight; whereas, in 1867, the sky was overcast till 1 A.M., and subsequently, when the clouds had partially or wholly disappeared, the visibility of the meteors was greatly impaired by haze and moonlight. But for these causes, the total number recorded last year would probably have been three times as great as in 1868.

"NUMBER OF METEORS COUNTED AT THE MAGNETIC OBSERVATORY, TORONTO, ON THE NIGHTS OF NOVEMBER 13TH AND 14TH, 1867 AND 1868.

	1867	1868
Before midnight	0	173
Midnight to 1 A.M. of November 14	20	329
1 A.M. to 2 " "	44	583
2 A.M. to 3 " "	123	489
3 A.M. to 4 " "	560	375
4 A.M. to 5 " "	1349	570
5 A.M. to 6 " "	195	365
Total	2287	2486."

ARCHÆOLOGIA.

A RECENT discovery of ancient PILE-WORK NEAR NORWICH has excited considerable interest among the antiquaries and geologists of that city. At Trowse, a little to the south of Norwich, and near the bank of the river Yare, excavations of some extent have been made for sewerage purposes, under the directions of A. W. Morant, Esq., the city surveyor. In the course of digging a deep trench on the side of Trowse Common, a series of wooden piles were brought to light, which passed through a bed of peat, into the hard gravel underneath. The level of the surface of the peat is that of the water of the present river Yare, and the bed itself is nearly three feet thick. It is covered with about the same thickness of white and yellow sands and loamy clay, above which is a foot of made earth. The piles appear to have been driven through the peat into the gravel, and it is assumed that the sand and loamy clay, with the made earth, in all between three and four feet, have been deposited since the piles were driven in. This, however, may not necessarily be the case, and it is at least a question which it would require a more extensive exploration to decide. The piles appear to have been all nearly of the same length, about three feet, and, of those taken out, each was pointed, and many bore rude marks of having been hacked into their present shape. All were found standing erect in the bed of peat.

At a meeting of the Norwich Geological Society, early in September, the circumstances of this discovery were laid before that body, in a short paper by Mr. Taylor, one of the Norfolk geologists. Mr. Taylor insists upon the great antiquity of this pile-work, and considers it to be the remains of a veritable crannoge, or lacustrine habitation, of the prehistoric period. In the discussion which followed, he gave it as his opinion that it belongs to the bronze period, or early iron age. We confess that we cannot ourselves see any strong reason for giving it anything like so great an antiquity.

Since the foregoing was written, we have received information that of these piles more recently taken up, exhibits very distinctly three cuts of what must have been an iron implement, and that probably of a much more recent period than the geologists seem to suppose.

In the first meeting of the season of the Archæological Institute, at the beginning of the past month, the subject of the PAINTED GLASS IN FAIRFORD CHURCH was brought forward for discussion, in a paper

on the subject by the Rev. J. Fuller Russell, who disputed nearly all the arguments which had been adduced by Mr. Holt in favour of this glass being the work of Albert Durer. With regard, especially, to arguments which Mr. Holt had pressed with some earnestness, that parts of the designs in Fairford windows, which were there of a very remarkable character, were found treated in the same manner in some of Durer's known works, such as a part of the "Crucifixion," the treatment of the lily and the sword in the picture of the "Doom," the peculiar forms of the nimbus, and several other characteristics, Mr. Russell showed, we think satisfactorily, that all or most of these are found in works of art of periods antecedent to the time of Durer, or, at all events, so contemporary that they must have been quite independent. These, of course, would go to show that Mr. Holt has been mistaken in some of his arguments, without deciding what we think still remains an open question. To judge by what took place at the meeting of the Archæological Institute, some of the most respectable of our authorities in mediæval art, including Canon Rock, Mr. John Green Waller, Mr. Westlake, and Professor Westmacott, are opposed to the claims thus set up for the authorship of the Fairford glass.

The last part of the *Archæologia Cambrensis* contains two remarkably interesting papers on the remains of PRIMITIVE VILLAGES in HOLYHEAD ISLAND. These remains have often excited the curiosity of visitors during many years, during which time many of them have disappeared, and the rest have been more or less damaged or defaced. These monuments are found scattered in groups over the rough uncultivated districts of heathy ground, offering at first sight the appearance of low mounds, covered with gorze or fern, which, when cleared away, brings to light a circular space, from fifteen to twenty feet in diameter, enclosed by a low wall of stones, and usually subdivided by other stones into more than one internal apartment. No more than five or six are generally found in a cluster, but in one instance the group is so numerous, that it must have formed a village of not less than fifty huts. The traditionary name given to them by the peasantry is Cyttiau'r Gwyddelod, *i. e.*, Irishmen's huts, on the supposition—a very natural one among the ignorant country people—that they were the habitations of early Irish settlers on this coast. In the passion for extreme remoteness of date, which characterizes too much the Archæology of the present day, these remains are beginning to be looked on as belonging to some one of the far distant prehistoric ages. The first of the papers alluded to above is by the Hon. Mr. Stanley, on whose estate these

curious monuments are found, and who has had them uncovered and explored, and he here describes, in a very satisfactory manner, the result of his researches. The domestic character of these enclosures seems proved beyond a doubt, by the existence within most of them of an arrangement of stones, which bear evidence of being fire-places, and by finding in some of them the querns of different forms which were used to grind grain, and the shells of shell-fish, and traces of other objects which had served for food. In one instance, in the midst of the site of these circles, and evidently connected with them, were found numerous bronze spear-heads, of different forms and sizes, as well as bronze celts, with rings of various sizes, armlets, beads of red amber, and other similar objects. Plans and drawings illustrate Mr. Stanley's paper.

The second paper to which we have alluded is a long and learned dissertation on the various relics found in and among these circular huts, from the pen of one of our ablest antiquaries, Mr. Albert Way. These consist, as already stated, of implements of stone for crushing and grinding grain, of round stones with holes in them, such as are usually considered to have been whorles for the spindle in spinning, and of other objects formed of stone presenting forms which are not new to the antiquary; of implements of bronze of the ordinary type; and of a certain number of personal ornaments, including an armlet, and several rings of bronze, and a considerable variety of amber beads. Engravings of most of these are given with Mr. Way's paper. It may be remarked, that remains of somewhat similar villages are found in various parts of England, and observations made among them led them to be considered by our best antiquaries as the habitations of the aboriginal inhabitants of those parts of the island during, at least, the earlier period of Roman occupation. This opinion had been confirmed by the not unfrequent presence of Roman coins, and other articles of Roman manufacture, among the objects found in them.

T. W.

PROGRESS OF INVENTION.

METALLIC DECORATIONS FOR PORCELAIN AND GLASS.—An ordinary silver photograph is produced on a film of collodion, and is then treated by the toning process, and so the image is coated with other metals; for example, terchloride of gold is employed when a golden image is desired, for a steel-coloured picture tetrachloride of platinum, for a black metallic design the silver photograph should be toned with a salt of iridium, for a brown design with palladic chloride. A design in metal of one colour can be obtained by first toning the image with the proper metallic salt, and then saturating the film with a solution of some other salt. The collodion film, when treated as described, can be transferred to porcelain or glass and the salt reduced by heat to the metallic state.

COMMUNICATING WITH DEAF AND DUMB PERSONS.—A simple and ingenious method of accomplishing this object with facility has been patented by Mr. Bertram Mitford of Cheltenham. He uses a hollow case of any convenient form or size, made of wood or other suitable light material, and this case is provided with a handle by which it is to be held in the hand of the person using it. On the side of the case which faces the user there are contained the letters of the alphabet, numerals, or other signs useful to persons holding conversation with one another; and upon the opposite side, which faces the person communicated with, there is provided an opening protected by glass. In the interior of the hollow case are placed a number of slides worked by buttons which traverse along slots arranged each immediately above a different letter or sign. The upper end of each of these slides carries the corresponding letter or sign to that marked on the case opposite to the particular button; and when any slide or button is pushed along the slot, the corresponding letter or sign will be presented at the glazed aperture on the opposite side of the case. By successively raising and lowering or moving the slides it is obvious that words can be easily spelt and communication be established with the deaf and dunb without necessitating a knowledge of the signs known as the deaf and dumb alphabet.

IMPROVEMENT IN CANDLE-STICK SOCKETS.—The employment of paper to make candles fit into a socket is inconvenient and prevents the consumption of the candle to its end, unless the dirty and unpleasant operation of withdrawing it from the socket, unwinding the paper, and placing it on a save-all be resorted to. Mr. Thomas Alfred Warrington, of Carlton Road, Camden Town, has invented a socket which is cleanly and convenient, and at the same time economical, in that it allows of the entire consumption of the candle. The socket is constructed of sufficient diameter to hold the largest candle made for ordinary use, and inside it are placed in a vertical direction four or more pieces of metal which project into its interior, and these are sharper at their free edge, which is near the centre

of the socket, than at the part where they are attached to it. It is clear that the circle which is described by touching the free edges of these projecting pieces is smaller than the circle of the socket, and this inner circle is so made as to be small enough to hold firmly the smallest candle in ordinary use. When a candle is pressed into this socket it is firmly held by the projecting pieces, and the very slightest introduction of it into the socket is sufficient to cause it to maintain the erect position, and so the whole candle can be burnt without the use of a save-all.

Sewing Machines.—Mr. Thomas A. Macaulay, of New York, has patented an invention, which is intended to make the Wheeler and Wilson class of sewing machines, by a simple change, capable of producing the chain stitch with one thread; and the invention consists in the use of a ring, which fits into the recess in the face of the ordinary rotating hook, in the place which the ordinary spool occupies; this ring having a projection from one edge, which passes across its diameter, and terminates in a hook, which turns towards the ordinary rotating hook. The needle passes between the ring-hook and the ordinary rotating hook. The ring-hook spreads the loop last formed by the ordinary rotating hook, so that when the needle next descends it passes through this loop, and while it is down, the ordinary rotating hook catches the needle loop, and when the needle is withdrawn, the loop then beginning to be formed, is drawn through the loop previously made, which is drawn tight by the loop, then in the act of being formed by the ordinary rotating hook. In producing the chain stitch by the above means, the little brush which acts upon the edge of the ordinary rotating hook is adjusted to hold the loop back longer than when making the lock-stitch.

Ornamenting and Enamelling Slate, Marble, etc.—Instead of ornamenting the surface of slate or marble and such like materials in the ordinary way, or by means of artistic paintings executed by hand, Mr. J. S. Geé proposes to use patterns and artistic paintings which have first been executed on lithographic stones and then printed on paper or other suitable materials. These lithographic printings are to be attached to the surface of the slate or marble by a proper cement, and the paper on which they were printed is to be washed away, and removed by friction; in this manner the designs are transferred to the slate; they may then be stoved and varnished and finished in the usual manner.

Improvements in the Preparation of Cigars, and Mode of Lighting the same.—This invention consists in an improvement in the preparation of cigars whereby they are rendered self-igniting, or capable of carrying the means of ignition without the necessity of resorting to any extraneous source of light, whilst at the same time they are, when so prepared, perfectly free from danger or probabitity of ignition when packed or during transit. In the first instance, the ends of the cigars which are intended to be ignited are dipped into a mixture composed of gum, nitrate of potash, charcoal, chlorate of potash, and water. This mixture

sets hard when dry, and it will not ignite by friction. Sheets of paper are then coated on one side with gum, and on the other with a mixture of gum and red or amorphous phosphorous; when this paper is dried, it is cut in strips which are rolled round the cigars about their middle, and are fastened by moistening the gum, care being taken not to let the paper adhere to the cigar, lest its removal might cause the cigar-leaf to be torn. When it is desired to light the cigar, the band should be removed, and struck against that end of the cigar which has been prepared with the composition of nitrate and chlorate of potash, and ignition will take place immediately.

TOBACCO-PIPES.—This invention will prove a great comfort to smokers, it is extremely simple, and appears to be well adapted to prevent what is at least unpleasant, if not unwholesome, namely, the passage of the tobacco oils into the mouth. At the bottom of the pipe-bowl, a conical piece, either of the same material of the pipe, or other material, projects up into the bowl some quarter of an inch to half an inch, the tube through which the smoke passes continues from the mouth-piece to the apex of this cone, now the tobacco below the apex of the cone absorbs the oil, and consequently, none of it can pass down the tube, neither can the tobacco moistened with the oil burn, for it is below the draught. The inventor and patentee is Mr. Charles Rockley, 46, Cannon Street, City.

CAPSULES FOR JARS, POTS, ETC.—M. Henry Viollet, of Tours, has invented a very simple and useful method of closing pots containing pharmaceutical, edible, and other non-liquid substances. He cuts a sheet of cardboard, or other analogous material, into the form and of the same dimensions as the top of the vessel to be closed; he then pastes or glues on to the edges of this piece of cardboard the edge of a ring or band of india-rubber, he then places over it a sheet of paper, or other analogous material, and interposes or not a band of paper or textile material, the extremities of which may be pasted or otherwise fixed to the vessel to be closed; the cardboard cover can now be placed over the opening of the jar and the india-rubber be drawn over the rim, and thus a joint will be formed.

LITERARY NOTICES.

SCIOGRAPHY; OR THE RADIAL PROJECTION OF SHADOWS. By R. Campbell Puckett, PH.D., Head Master of the Bath School of Art. (Chapman and Hall.)—This is the only work we have met with, presenting to the art student in a comprehensive form, the rules for drawing shadows in true prospective. The author tells us that it arose out of the lessons and black board diagrams he prepared for the Bath School. Each chapter is illustrated by an appropriate diagram, showing the principles

of shadow-perspective, when the sun's rays occupy various positions in reference to the spectator and the object. The work is necessarily of a technical kind, intended for study, not for mere perusal, and quotations from it would scarcely help the reader to judge its merits. It is intended to follow a course of linear prospective, and would only be intelligible to those who have acquired a preliminary knowledge of that subject. To students in that position we have no doubt it will prove of much use.

Thoughts on Ireland. By the late Count Cavour. Translated by W. B. Hodgson, LL.D. (Trübner and Co.)—This translation is very opportune, as the Irish question, though not admissible into the Student, demands the gravest attention, and Count Cavour's character, and remarkable ability as a statesman, will ensure respect for his deliberate opinions upon a subject which he appears to have studied deeply, and with goodwill to all the parties concerned.

A Handbook for the Nursery. Being a Plain and Concise Description of the Diseases Peculiar to Infancy and Childhood, with Directions for their Treatment, and How to Proceed in Cases of Emergency. By Dr. Robert Charles Croft, Licentiate of the Royal College of Physicians of Edinburgh, etc. Fifth Edition. (Humilton, Adams, and Co.)—This is an excellent little work, which we can strongly recommend to those who have filled, or intend to fill, their quivers with the arrows of the righteous.

Bible Animals. An Account of the Various Birds, Beasts, Fishes, and other Animals mentioned in Holy Scripture. By the Rev. J. G. Wood, M.A., F.L.S., Author of "Homes without Hands." Copiously Illustrated with New and Original Designs made under the Author's superintendence, by F. W. Kehl, T. W. Wood, and G. A. Smith, and engraved on Wood by George Pearson. (Longmans.)—We have only to remind our readers that this popular work keeps up its character in successive numbers, and is well calculated for a gift book.

The Mysteries of the Ocean. Translated, Edited, and Enlarged from the French of Arthur Mangin. By the Translator of "The Bird." With 120 Illustrations by W. Freeman and J. Nöel. (Nelson and Sons.)—We would gladly speak well of this remarkably handsome volume, if its contents were at all worthy of the pains the publishers have bestowed upon it; but it belongs to a class of works that ought not to escape severe censure, and, except for merits of paper, typography, etc., it is one of the worst of its kind. Science ought not to fall into the hands of vulgar sensation-mongers, who misrepresent its facts, distort its reasoning, and treat great subjects as if they were exhibiting sham monsters at a country fair. "The Mysteries of the Ocean" begins with the following bosh:—"The ocean is the eldest brother of the continents, the loving father of the first creatures endowed with life," etc., etc. And then follows an account of the birth of the ocean from the union of gases, and

the cooling of an incandescent globe. The second chapter deals with water, and we at once come upon a blunder, in the statement, "that the freezing point of water, unlike its boiling point, is not susceptible of variation,"—the exact contrary being the fact. Turning from M. Mangin and his translator to a real man of science, we find the following in Mr. Balfour Stewart's excellent "Elementary Treatise on Heat." "Professor James Thomson, of Belfast, anticipated theoretically the truth, that the melting point of a body which expands in congelation would be lowered by pressure, while that of a body which contracts in congelation would be raised by it. His brother's idea was verified, experimentally, by Professor W. Thomson, of Glasgow, who showed that by a pressure of 16·8 atmospheres, the freezing point of water (a substance which expands when freezing) was reduced to 0°·232 Fahr. . . . Mousson was able to lower the temperature of freezing water from 0° to —18° C."

In the page following the error just noticed, is another very stupid one, in the words, "Nor must we forget that any body which is soluble in pure water becomes insoluble, and, as the chemists say, precipitates itself, on combining with another body." The caustic alkalies, for example, are soluble in water, and do not precipitate themselves, if we add hydrochloric acid, which unites with them. Many similar instances might be given. The third chapter is occupied with a wild account of the behaviour of our planet as it cooled and solidified; and, turning, to the fourth, which is designated "Pluto and Neptune," we immediately come upon another erroneous statement, that, "even to-day the thickness of the earth rind is computed at no more than 17,500 yards," or less than 10 miles. No geologist of reputation supposes anything of the kind, and Mr. Hopkins's researches, though they have not been universally accepted, give a probable thickness of about 800 miles. In the beginning of the fifth chapter there is another doubtful statement, that the rocks formerly called Plutonian have an origin "exclusively igneous." The writer does not seem aware of the reasons for supposing that water as well as fire was concerned in granitic formations. In the same chapter Sir C. Lyell is absurdly stated to have "elaborately demonstrated that the actual configuration of the earth is the result of a prolonged succession of *sudden phenomena and violent crises*." Cuvier is also quoted in defence of spasmodic theories of geology, now universally discredited by a more accurate acquaintance with facts.

As soon as the writer comes to speak of the minute inhabitants of the sea, he is ludicrously eloquent:—"the waters are literally composed of them," "they are the 'living waves' of Scripture," the "world makers of M. Michelet," and more of the same sort. "Let us consider by itself," exclaims our voluble showman, "at the bottom of the seas, one of those invisible architects. He seizes upon the elements in suspension in the water; he elaborates them, triturates them in his powerful ringed stomach, finally transforms them, and extracts the calcareous secretions

destined to embellish and extend the coral palace which serves them for a dwelling-place."

It is by no means easy to tell what the writer of this rubbish really means, or what kind of an invisible architect he intends to describe, but no notions can be extracted from his silly verbiage that are not ludicrously wrong. The chapter about sea phosphorescence contains no intelligible account of the *noctiluca*, or any other known cause of the phenomenon, but rushes into what the writer takes for poetic inspiration, and he exclaims, "These organized atoms, these imperceptible zoophytes, are the torches of the ocean: they possess that subtle principle which all religions, all philosophies, all poetries have proclaimed to be the emblem of the Divine mind—Light. And this viscous, fatty matter, the residuum of the decomposition of innumerable beings, plants, and animals, this mucus secreted by fishes, is yet a source of light! What do I say? It is a source of *life*—it is the universal nutriment of the oceanic flora and fauna. It is the *milk* in whose centre are born, and upon which are nourished all those ephemeral creatures, so weak and so delicate, the infusoriæ, mollusks, and radiates—those infinitesimal atoms, whose power," etc., etc. How any sane Englishman could translate such trash, and persuade any publisher to issue it, is a mystery of the land, quite equal to any "mystery of the sea." A little further on, foraminifera are called zoophytes, and a very unsatisfactory account is given of coral formations. The author's notions of classification are very antique. He tells us that "the first animals produced after the infusorias and microscopic zoophytes in the still more dense waters of the primeval seas, were, in *the class of* zoophytes, radiata of the echinodermata family, sea-stars and sea-hedgehogs," etc. Having got as far as stone lilies, he tells us that "next follow the bryozoa, the molluscoids, and the mollusks properly so called, all protected by strong shells. These are the branchiopoda (branch-like feet), pteropoda (winged feet), and principally cephalopoda, with heads that serve as feet"! We do not know what is meant to be asserted in this strange sentence, but it looks as if branchiopoda was put for brachiopoda, and that the author did not know what the term meant. The explanation of cephalopoda is very funny, and, so far as we know, original. After some account of the fossil reptiles, it is alleged that they finished their course, when food was scarce, by eating each other up, and thus making room for generations of superior animals.

In "sponges," M. Mangin informs us, "nutrition and respiration are one and the same function, which they accomplish by absorbing the aërated water. Their growth is *derived* from the augmentation of the *glutinous parenchyma*, in which are deposited the elements of their *osseous* framework." He further informs us that naturalists do not know how sponges die, and he settles the matter by affirming that they perish by "ossification or petrifaction," and by the "final substitution" of "mineral elements for the totality of the spongeous tissue." By killing them in

this way, he considers "we may be permitted to endow with existence the siliceous and calcareous sponges which have been taken for distinct species of the horny sponge, of which they can only be the carcasses"!

The way in which this unfortunate work is got up is highly creditable to the publisher; and though some of the illustrations err on the side of the sensational, they are far too good for the generally worthless character of the text, and should reappear in a better book.

Elements of Heat and of Non-Metallic Chemistry, Especially Designed for Candidates for the Matriculation Pass Examination of the University of London. By Frederick Guthrie, B.A. (Lond.), Ph.D., F.R.S.E., F.C.S., late Professor of Chemistry and Physics, Royal College, Mauritius. (Van Voorst.)—In an elementary treatise, and one which is recommended by the author as sufficiently comprehensive to serve for self-instruction, great precision and accuracy are necessary, as the student has no one to whom he can appeal for the explanation of ambiguous sentences, or who can correct him, if the author he trusts in leads him astray. Moreover, it is unwise to raise doubts in the mind of a student concerning theories before he has become acquainted with facts. It would be better to leave out those theories which are questioned altogether. We will give a few examples from Dr. Guthrie's book, as showing why we can hardly recommend his treatise for the purpose for which he designs it. In the chapter headed "Atomic Hypothesis," page 79, he says: "Thus if the one gas A resulting from the union of 12 parts by weight of carbon with 32 parts by weight of oxygen, consist of twice as many atoms of oxygen as of carbon, it follows that the weight of an atom of carbon is to that of an atom of oxygen as 12 is to 16." And again, at the bottom of the same page, he says: "It must be borne in mind that it is entirely a matter of guess and convenience, when it is affirmed that the gas A contains two atoms of the one element to one atom of the other. There is no evidence whatever to prove that such is the case; and indeed in many similar cases the opinions of chemists differ." From the first statement he concludes that the weight of an atom of oxygen is 16, and that of an atom of carbon is 12. From his second statement it is clear that one has just as much right to assert that the atom of carbon is 6 as 12. Again, page 82, Dr. Guthrie asserts that the "*atomic weight*, the *combining proportion by weight*, and the *equivalent* of a body have nearly the same meaning." At pages 72, 73, he gives a list of symbols and combining weights. On reference to this, it will be found that the combining weight of oxygen is 16, that of chlorine 35·5 that of sulphur 32, and that of hydrogen is 1; *i.e.*, 16, 35·5, 32, and 1 are the equivalents of oxygen, chlorine, sulphur, and hydrogen respectively. At page 82, he says: "If 1 lb. of hydrogen unites with chlorine, 35·5 lbs. of chlorine are required; if with oxygen, 8 lbs. are sufficient; if with sulphur, 16 lbs., and so on. The equivalents of oxygen, sulphur, and chlorine would therefore be 8, 16, 35·5, if, the equivalent of hydrogen

being 1, in all three cases the elements united atom for atom." Now, which does Dr. Guthrie mean to say is the equivalent of oxygen, hydrogen being 1, 16, or 8? At the bottom of § 33, he says, "We shall take the equivalent of hydrogen as 1, and adopt the equivalent numbers given in § 6, 11"—that is, oxygen 16. But he has shown, as quoted, that oxygen combines with hydrogen in the proportion of 16 to 2, therefore one part of hydrogen is clearly equivalent to 8 parts of oxygen. The greater part of this chapter is so indefinite that it would be impossible for any student to understand what is meant by the "atomic hypothesis" by studying it. Chap. IV., page 93, an acid is said to contain hydrogen, and again it is asserted that "the term acid is frequently, but somewhat improperly, applied to bodies which do not contain hydrogen," and CO_2 and SO_2 are cited as instances of this error. This may be true or false, still Dr. Guthrie should be consistent with his theory, if he wishes to teach students on what he considers to be sound principles. At page 179, he calls SiO_2 silicic acid; at page 171, P_2O_5 phosphoric acid; at page 130, CO_2 carbonic acid; at page 119, N_2O_3 nitrous acid, etc. At page 95, he says: "Salts, even when soluble in water, often take no effect upon vegetable colours, and are then said to be *physically neutral.*" Is the action of an acid substance on a vegetable colour, say litmus, a physical action? We shall conclude with one more extract: "It is evident that the more soluble a metallic oxide is in water, the more readily will it neutralize an acid. Those metallic oxides which are the most soluble in water are called alkalies, and their solutions are called alkaline. The metals which such alkalies contain are called alkaline metals. The chief of these are potassium and sodium. An alkali, therefore, is a very soluble base," page 96. What about magnesia, lime, etc., etc.? What is an alkali?—Answer: a very soluble base. Would such an answer satisfy the examiners at the University of London?

Dr. Guthrie has undertaken the hopeless task of teaching modern chemistry without first learning it himself.

Appendix to the Manual of Mollusca of S. P. Woodward, A.L.S., containing such Recent and Fossil Shells as are not mentioned in the Second Edition of that Work. By Ralph Tate, A.L.S., F.S.S. (Virtue and Co.)—Purchasers of the second edition of Dr. Woodward's well-known work will be glad to complete it by this Appendix, which Mr. Tate was well able to compile. The etymology of the names is always given, and the descriptions are concise and clear. It contains 86 pages, including the Index, and is neatly bound in cloth.

NOTES AND MEMORANDA.

ACTION OF FROST ON TIN.—M. Fritzche states in "Comptes Rendus" that some blocks of tin exposed to severe frost last winter had their molecular constitution quite changed. They became crystalline through their whole mass, and had a basaltic aspect. Cavities were found inside the blocks, with smooth walls exhibiting metallic reflexions, while the rest of the tin was disintegrated into small grains, or larger fragments of a dull aspect, probably due to superficial organization. He remarks that these phenomena are known to persons engaged in the tin trade, but that with the exception of a case mentioned by Erdmann, in which the tubes of an organ became crystallized, he is not aware of any publication on the subject.

ASSAY OF SILVER.—To avoid the errors resulting from the slight solubility of chloride of silver, M. Stas advises to use a bromide instead of a chloride in silver assaying.

THE EARTHQUAKE-WAVE IN SOUTH AMERICA.—M. Pissis states that the seismic, or shock-wave in the great South American earthquake of the 13th August, 1868, appears to have travelled at the rate of 474 kilometres, or about 294 miles in an hour, taking Arica as the centre from whence the undulations started.

DREDGINGS IN THE GULF OF GASCONY.—M. Fischer communicates to the French Academy the results of recent dredgings and soundings in the Gulf of Gascony. The south-west shores of France slope gently towards the west, and constitute a submarine terrace, limited to a depth of 200 fathoms. In the middle it is only 45 to 60 fathoms, and on the western boundary from 90 to 100. Mollusca were obtained from it not previously recognized in France, such as *Neæra castellata*, *Psammobia costulata*, *Lepton nitidum*, *Leda tenuis*, *Arca pretunculoides*, *Lima subauriculata*, *Scissurella crispata*, *Cyclostrema nitens*, *Rissoa soluta*, *Eulima bilineata*, *Mangelia borealis*, *M. elegans*, etc., objects found near the English and Norwegian coasts. A great avicula bank was also detected.

DEEP SEA SHARKS.—Dr. E. P. Wright states, in "Annals Nat. Hist.," that near Setubal, a fishing village, connected with Lisbon by rail, he saw fishermen let down 600 fathoms of rope with hooks attached to the first thirty or forty fathoms, and after a time, when hauled in, they had caught five or six sharks, from three to four feet long, which fell into the boat like dead pigs. It seemed as if the rapid change of pressure had asphyxiated them.

GREAT RAINFALL.—"Cosmos" states, on the authority of M. Belgrand, that between October 17th and 18th (1868) there fell in eight hours, at Clermont-l'Herault, more than seven inches of rain. M. Renan remarks, that on the 20th May, at Molitig, near Prades, Eastern Pyrenees, more than twelve inches of rain fell in an hour and a half.

EXPERIMENTS WITH A SEVERED HEAD.—Claude Bernard (quoted in "Cosmos") refers, in his "Report on the Progress of Physiology in France," to an experiment of Brown-Sequard, in which the head of a dog, severed from its body, exhibited movements which appeared voluntary on being influenced by arterial blood injected through the caratid. Claude Bernard remarks, that it would be false reasoning to assume from such an experiment that the intelligence resided in the blood, or the brains. All that occurred was the restoration to a vital organ of the conditions necessary for its action.

THE TRICHINA AT BERLIN.—It is reported that several persons have been recently infected with the *Trichina spiralis* at Berlin, through eating uncooked or underdone pork. Two of them were in a dangerous state in one of the hospitals. This pestilent parasite is well known to microscopists, coiled like a snake in little cells. It multiplies enormously in the human muscles, when it is unfortunately swallowed alive. No prudent person would eat underdone pork.

INDEX.

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